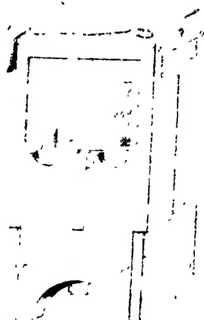
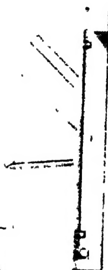
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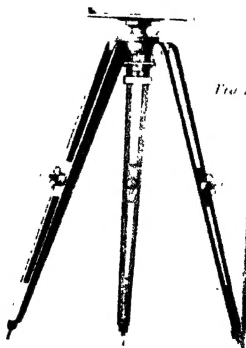












A

TREATISE ON PHOTOGRAPHY;

CONTAINING THE

LATEST DISCOVERIES AND IMPROVEMENTS APPERTAINING TO THE DAGUERREOTYPE

BY N. P. LEREBOURS,

OPTICIAN TO THE OBSERVATORY, PARIS, ETC., ETC.

COMPILED FROM THE IMPORTANT COMMUNICATIONS OF THE UNDERMENTIONED SAVANS AND INDIVIDUALS,

DAGUERRE	CLAUDET	MOSER
ARAGO	DRAPER	GROVE
BECQUEREL	FIZEAU	KARSTEN
TONY GAUDIN	TALBOT	KNORR

AND OTHERS.

TRANSLATED BY J. EGERTON.

LONDON.
LONGMAN, BROWN, GREEN, AND LONGMANS.

MDCCCXLIII.

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PREFACE OF THE TRANSLATOR.

THE publication in English of Mr. Lerebours' celebrated Treatise on Photography, has been considered by the Translator, and several highly scientific friends and admirers of the art, as a desideratum which would be very acceptable to the public, and to the scientific world in general. Under this conviction the task was undertaken. This Treatise contains, the most familiar and practical details relative to the approved manner of manipulating throughout the different processes of the art—valuable hints respecting the choice and purchase of the plates, apparatus, &c.—the method of preparing the various chemical substances employed, and minute considerations on every feature connected with the subject: a uniform attention to all which, cannot fail to give the operator successful results. It comprises, moreover, all the recent discoveries

and improvements suggested by the researches of the most eminent scientific men, at home and abroad, whose attention has been so ardently devoted to the cultivation and progress of an art which has excited the wonder and admiration of the present generation. These labours have given to the discovery of Mr. Daguerre a degree of perfection, which seems almost incredible, considering its brief existence. In addition to the foregoing, will be found an account of the singular phenomena discovered by Professor Moser, and the various theories propounded thereon, by different philosophers; all of which claim a place in a Treatise of this description, as they afford valuable data, which no doubt will one day serve, when men of science are better agreed as to their origin and nature, to explain the rationale of the various phases of the Daguerreotype process. The Translator has been enabled, through the kindness of Mr. Lerebours, to add to this work the communications just made to the Academy of Sciences in Paris, by Messrs. Choiselet and St. Ratel; also by Messrs. Belfield, Lefevre, and Leon Foucault. The reader will observe, that the new theory point . out by

these gentlemen and the processes founded on it, are, in some respects, opposed to the opinion of Mr. Daguerre, and seem to favour the conclusions of those who, in denying the inferences drawn by Moser from the phenomena discovered by him, attribute their existence to the presence of organic matter, which, they allege, covers the surfaces of all polished bodies. Not having had time to test these new processes by experiment, the Translator can offer no opinion on the merits or demerits of this innovation; but he remembers seeing, about two years ago, the most beautiful specimens of the Daguerreotype then in existence, produced by Mr. Cornelius, of Philadelphia, whose reputation is not confined to the western hemisphere, by a process bearing some analogy to the one proposed.

In addition, will be found Dr. Draper's valuable note on the Tithonotype, which explains how easily beautiful copies of the Daguerrian image may be obtained, equal in every respect to the original, by the Electrotype process.

It is the intention of the Translator to make this a standard work, by publishing, from time to time, subsequent editions, so as to keep pace

with the improvements and discoveries which may be made in the art. It is, likewise, his intention to commence, forthwith, a course of methodical instruction, practically applied; and, for that purpose, he has made suitable arrangements to receive pupils at the undermentioned address, where they will have the advantage of the best constructed apparatus and chemicals, as sent direct from Mr. Lerebours' establishment in Paris.

In conclusion, the Translator will only observe, as to the merits of the Translation itself, that he has aimed at making it a faithful reflex of the author's meaning, and has endeavoured to render it perspicuous rather than elegant or ornamental.

J. EGERTON.

1, Temple-street, Whitefriars,
Sept. 15, 1843.

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INTRODUCTION.

The third edition of this work, of which we published, in the month of May, 1842, 1,800 copies, having been all sold, we have determined on bringing out a new one. As we could not pass unnoticed the additions and alterations since made in this art, many of which we have ascertained to be useful and valuable improvements, we have written anew all that part which relates to the different operations; and it is by following the directions given in the course of this work for executing these operations, that we have been enabled to produce those beautiful proofs which are daily to be seen in our collection.

We have, therefore, in the first part, devoted our attention to describing, in the clearest manner possible, the new processes which have been adopted and practised in our portrait department; and we have added, in the form of notes, some particulars and facts which appeared to us to be worthy of notice.

We feel bound to express our sincere obligation to our friend, Mr. Claudet, for making known to us, without the least reserve, some important improvements, which many others in his situation would have

kept secret. Those who have had an opportunity of admiring the numerous superb portraits presented by him to the Institute of France, will doubtless be eager to adopt his discoveries and improvements, described in the course of this work, and particularly those contained in the chapter relating to the polishing of the plates. These processes are the surest and most expeditious, and the operator will obtain, by their adoption, finer and more vigorously-toned impressions, than by any of the methods hitherto known.

Last year, in speaking of the accelerating substances, we represented the bromide of iodine and the bromine-water as being attended with equally advantageous results, but we can now be much more explicit. We can, on this occasion, express ourselves in accordance with the notions contained in a manual on photography, in which every one is not treated with *equal favour*, but which, nevertheless, has in its pages some excellent articles; and we say, in the words of the author:*—"The bromine-water is undeniably the most active, the most simple, and the

* We had at first thought of answering some of the numerous assertions contained in that work, which, to say the least, were made upon slight grounds; but, upon reflection, we thought that those epigrammatic innuendoes and insinuations, in which one must necessarily speak of self, are not at all relished by the reader, who requires only to be instructed. Besides, we declare it plainly, that style of writing, *to which we were never the first to have recourse*, is very repugnant to us; as we think there is no compensation in satisfying, for a few short moments, one's self-love, when this paltry satisfaction may tend to impair the sentiments of esteem which honourable men mutually owe one another.

most perfect accelerating agent that has yet been employed in photography."

We do not profess to maintain that perfect results are only to be obtained by the use of the bromine-water. Mr. Tony Gaudin has proved that the bromide of iodine, when properly prepared, has equal sensitiveness; but the greatest difficulties must be encountered before the *maximum* of sensitiveness is reached; which, on the contrary, may be obtained immediately, and without any trouble, by the use of the bromine-water at a proper degree of strength.

The flat pans which we recommended last year, with a certain degree of hesitation, having been tested by experience, and generally approved and adopted, we have endeavoured further to improve them, and think we have succeeded in that object, by simplifying the operation of the dosing, and by making them so as to serve either for plates with frames, or for naked plates.

Our readers will find in the same chapter a description of the *brass* frames, first used by Mr. Claudet, and already adopted by a great number of operators, for carrying about, and preserving, the bromined plates.

.The choice of the greater number of amateurs having been directed more to the production of portraits, than to views or landscapes, they, as a matter of course, have sought after the object-glasses which operate with the greatest rapidity. On this subject we can confidently repeat, what we said in our last

year's edition; viz., that we have never found any combination for the plates of small dimensions; that is to say, for the plates of the $\frac{1}{6}$ size, which operated quicker than the object-glass of our apparatus of the $\frac{1}{6}$ size, which we term the portrait apparatus.*

When, on the contrary, it is requisite to operate upon the larger-sized plates; viz. for the quarter, half, normal or standard sized plates, and the extra-sizes; there is a very great advantage in using the double object-glasses, which can, with the same length of focus, and without giving any visible traces of aberration, admit of a larger opening than a single lens, and consequently more light.

"The object-glass," says M. de Valicour, "is undeniably the most important part of the photographist's apparatus, and *has justly been termed its soul.* It is therefore to the choice of a good object-glass, that the amateur should chiefly direct his attention. In vain would he scrupulously adhere to all the other conditions of success, in the various processes employed; he would never obtain a good picture without a perfect lens: but as it is only after long use, and numerous experiments, that the qualities of a good lens can be ascertained, it is important to procure

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* It is evident that, with the same accelerating substance, the rapidity of the operation can only be increased by shortening the focus of the lens; but, as this shorter focus can only be attained by having a lens with stronger curves, it follows that a great number of apparatus with one or two object-glasses, and got up with little care and upon no scientific principle, will give images *clouded and indistinct all over the plate, and entirely deformed towards the edges.*

one from an optician, whose reputation and standing oblige him to furnish none but such as are perfect. Many persons have lost their predilection for photographical essays at the very outset, because they had bought hap-hazard the first Daguerreotype apparatus they met with, and the impressions they obtained were necessarily defective, in consequence of having a defective object-glass."

This advice is excellent: persons desirous of purchasing an apparatus cannot be too strongly urged to apply to opticians of respectability and talent in their profession, and whose name is a guarantee of the goodness of their instruments. We may say of ourselves, that we take great pains to give complete satisfaction in this respect; at the same time, candour requires that we should add, that there are in Paris several houses, besides our own, where the same certainty of being supplied with good instruments will be found to exist.

Our readers will see, in the chapter containing a description of the apparatus, that we have adopted, for all the sizes except the sixth, curved plates, by means of which all traces of aberration are got rid of.*

* We fully expect that it will be said—You only adopt curved plates because you cannot obtain with your object-glasses, on a perfectly flat plate, an image of the same distinctness towards the edges as in the centre. This reproach cannot be seriously maintained, for we defy *any maker* to produce a double object-glass of an opening of $0^{m}.08$ without a diaphragm, *and of the usual focus, that is, a focus of* $0^{m}.27$, which shall give the image of a *flat object* in a manner perfectly distinct *on all the parts of a plate which has not been curved.* This difference in the distinctness of the image will be but trifling; we are aware of it; and

In respect to the wood-work of the apparatus, we have chosen the walnut-tree wood, as that which combines the most advantages. We do not use any varnish, for obvious reasons; and we have chiefly directed our endeavours to availing ourselves of every improvement hitherto known, preferring to sell a *complete*, and, above all, a *conveniently* arranged apparatus, rather than a showy or cheap one, not heeding whether we thereby enhance the price by a few francs: in a word, rather than diminish the price to the detriment of the quality, we have endeavoured to get up every article of our apparatus in as perfect and highly-finished a state as possible. The amateurs of photography are, of course, the only competent judges; and they can compare our articles with those of our competitors, and decide accordingly.

In the second part, we have pointed out the best methods of reproducing views, or landscapes, interiors, living models, portraits, &c. We have omitted nothing that experience has taught us on this subject, which is daily practised in our establishment;

even that it would escape the observation of most persons; but we really see no reason why a maker should scruple to acknowledge that such is the case, and especially why he should refuse to avail himself of means which, without complicating in the least the machinery of the apparatus, gives it a slight additional degree of perfection. This opinion, moreover, is not exclusively our own, and we can support it by unquestionable authority; for at the very time that we thus first expressed our ideas on the subject, we received a visit from Mr. Daguerre, whose opinion we asked, and his answer was, that notwithstanding the slight inconveniences attending the use of curved plates, we ought not *to hesitate in adopting them for all the large-sized apparatus with a short focus.*

and we have thought it our duty to add several useful extracts, which we have taken from the notes of different authors who have written on this art.

We call particular attention to the third part, which, besides other useful matter, contains the excellent notes of Mr. Fizeau on the bromine-water. It comprises all the directions necessary for preparing the various substances and compounds used in photographic experiments. We thought it would be advisable to collect all these notes and present them together to our readers, as they were hitherto only to be found scattered in various works which are but little read, and which are, in some instances, difficult to obtain.

In conclusion, it appeared to us that all experiments, having a more or less direct relation to the Daguerreotype, and which are of the highest interest to those who study the physical sciences, ought necessarily to have a place in a treatise like the present, which we were desirous of rendering as complete as possible. We have, therefore, inserted, with full details, the preparations of the various kinds of sensitive paper. Lastly, after having made some remarks on the reproduction of impressions by the electrotype, we have mentioned some attempts at engraving photographic impressions, Mr. Moser's experiments, &c., &c.



A

TREATISE ON PHOTOGRAPHY.

First Part.

CHAPTER I.

DESCRIPTION OF THE APPARATUS AND OF THE METALLIC PLATES.

The apparatus of different opticians may be more or less perfect, the object-glass may be single or double, the results obtained more or less satisfactory, they may be, moreover, more or less complete; but as all of them contain the several articles which we are going to describe, this description will equally serve for all, of whatever manufacture they may be.

As the first operation for obtaining a good photographic impression consists in the polishing of the plate, the first article to which we must call attention is the board on which the plate is cleaned, and which is represented in fig. 1.

Fix the clamp, A B, on the edge of a table; screw tightly with C, and slide one of the angles of the plate into the small permanent opening, *a*; the other small opening, *b*, being moveable and with a slide,

serves to receive the opposite angle of the plate; then tighten the screw at this angle, by means of which the plate is kept steady during the cleaning, and let out when that is done.

The substances used with the plate on the polishing-board are the small bags of rouge and tripoli, or the small bottles closed with gauze, as recently proposed by Mr. de Valicourt. Mr. Claudet's velvet buff, with handle, may also be used (see fig. 2), but only to give the *finishing touch*.

When several plates are prepared at a time, they may be put into the plate-box (which it is unnecessary to describe), after having wiped the edges and back of each plate. But it is better to place them two by two, with the silver sides facing each other, with the frames used by Mr. Claudet between them (fig. 3). When a frame has been thus placed between two plates, they should be wrapped up in tissue paper until they are wanted to be put into the iodine-box.*

We have shown (fig. 4) a section of our iodine-box. At the bottom is seen a layer of cotton wadding, sprinkled with particles of iodine; *a b* is a flexible piece of pasteboard encased between slips of glass, which must be wiped from time to time.

If the plate does not become iodized quick enough, reverse the frame which holds the piece of pasteboard, and by that means, the bottom side being

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* After having been subjected to the action of the iodine, and to that of the bromine, the plates may be kept in the above manner for several hours.

saturated, the operation is quickened; and, thus alternately reversed, will always be ready for iodizing another plate.

Fig. 5 is a square flat pan for containing the accelerating substances. These pans, which we were the first to bring into use, by the advice of a distinguished amateur of physical science, Mr. de Nothomb, of Longlaville, are much more convenient than the conical cups; by means of a small varnished frame, which is attached to each of those pans, and which rests on the ledges *a b*, the plate may be used either naked, or with its frame. The glass cover, *c d*, is ground near its edges, so as to prevent all evaporation.

The camera is nearly of the same construction in all the apparatus hitherto used. That which we think the best for portraits of small dimensions, and which is classed in our price current under the title of *New Daguerreotype for Plates of the* 1-6*th size*, is represented at fig. 6.* We have adopted the arrange-

* In our last edition, published in May 1842, we made the following remarks:—"Although Mr. Daguerre had made numerous researches on this point, the many constructions of apparatus of such a variety of sizes which have since been made,† must necessarily have led to the know-

† In December 1839 we made an apparatus which gave us some very fine impressions, 12 inches by 15 (French measure). In mentioning this result, it is not that we consider it as a difficulty overcome, but only to give a proof that we have been unceasingly and actively engaged in making all possible experiments relative to the progress of the photographic art. With our present apparatus, mounted with a double object-glass, we produce on similar plates views in fifteen seconds, and portraits in the shade in one minute.

ment suggested by Mr. Tony Gaudin, with whom originated the idea of placing the object-glass even with the front of the apparatus. The numerous experiments which we have made enable us to *affirm* that, as compared with a great number of *double object-glasses*, made by the best opticians, for plates of the same dimensions, our object-glass, whilst producing an equal degree of clearness in the impression, will always be found to be superior, in point of rapidity of execution, in the proportion of one-fourth.

We have retained for this apparatus the use of variable diaphragms, and they are the same as those used in microscopes, which our head workman in that department adapted, two years ago, to Mr. Gaudin's apparatus;* and we have imitated that instrument in

ledge of new curves obtained by some of these different methods. It was by a result of these experiments with different-sized apparatus that we were the first to introduce, three years ago, an apparatus calculated to produce a portrait in two minutes. This result, which was then thought very rapid, was produced by three causes: first, the short focal length of the object-glass; secondly, the proper selection of the curves; and thirdly, the excellent quality of the glass. We have, since then, still further improved upon this, by the adaptation of variable diaphragms, the relative sizes of their openings being more accurately arranged. With this apparatus thus improved, we are now able to produce, with the use of bromine-water, views in less than one-tenth of a second, and portraits in the shade, by using the large diaphragm, in a fraction of a second. In the first, the figures, carriages, and horses which are not moving too rapidly, are represented on the plate; from that to the instantaneous reproduction of an object there is but one step.

* The variable diaphragms, *b c d*, are placed at will before the object-glass; with the knob, *a*, you bring before the glasses the opening which is best adapted to the intensity of the light, and also to the degree of distinctness which the subject requires. Two examples will suffice to make our-

the use of the small curtain, which is the only means that can be employed to uncover the object-glass quick enough to reproduce with exactness objects in motion, and to mask the sky in landscapes.

As many persons have found much difficulty in using the naked plates, we have constructed an apparatus adapted for using the -' .te naked, or with a frame; those which e with a frame are provided with two, by which means two plates can be had ready for use. We consider this addition indispensable, for, as the exposition of the plate to the action of the mercury lasts from a quarter to half-an-hour, the consequence was, when but one was used, that the operator was obliged to remain doing nothing during all that time. The sliding-frame, A B C, serves to adjust the focus, whilst at the same time it enables the operator to judge, by the ground-glass, of the effect and position of the object to be reproduced. With regard to the focus, it is easy to trace on this sliding-frame marks for adjusting it, adapted to

selves understood: if you wish to obtain an instantaneous view with the objects in motion, you must ma' · use of the largest opening, *d*; for you cannot proceed too quickly to reproduce moving objects. If you wish to reproduce a view with such a degree of distinctness, that the objects situated near the edge of the picture be as clearly marked as those in the centre, use the diaphragms, *c* and *d*. The portrait of a handsome person should be executed with one of these small openings; for the smaller the opening of the diaphragm, the greater degree of minuteness will there be in the impression. If, on the contrary, you have to take the likeness of a person who has wrinkles, or who is pitted with the small-pox, or one who has unpleasant features, then use the large opening, and you will obtain one of those soft and rather vague likenesses which painters call "*flous*."

different distances, which must be done with the greatest exactness.* When the sliding-frame has been brought to one of these divisions, the small screw must be made tight, in order that the focus may not be changed during the operation. This apparatus is contained in two distinct boxes; the advantages of this arrangement, which is *more complete than any other*, and which preserves the camera and the

* When you wish to make use of these adjusting marks or lines, you must not use the rack, which is only really useful for the intermediate distances; the tube which it moves must therefore be entirely pushed in or drawn out. After having put in the ground-glass frame, you must bring the opening *c* before the object-glass, and direct the apparatus towards the landscape. When the image has attained its highest degree of distinctness, trace a line on the board, *e f*. For all landscapes, bring the drawer to this mark; then draw another line for the distance of two mètres (about 6½ feet), which is the most proper one for reproducing groups. Lastly, draw a third line for the distance of 1 mètre 50 centimètres (about five feet), which is the distance best adapted for taking the portrait. By this means you will never have occasion to seek the focus on the ground-glass, which always takes up much time; it will be sufficient to obtain the focus exactly, once for all, for the different distances that we have pointed out above; and for that purpose you may make use of letters with advantage. It will therefore be only necessary to bring at each operation the sliding-frame to the adjusting line, and to place the object or the person at a distance approaching that by which this point has been determined, which is easily done by a tape measure. †

† The difficulty which many persons have experienced in tracing these adjusting lines with precision has induced us to trace them ourselves. Our apparatus will therefore be delivered properly marked for the distances usually required. For the other distances, you must of course use the rack; only, as the focal distance varies a little, according to the diameter of the opening in the diaphragm, you must bear in mind that in all double apparatus, the adjusting lines for portrait distances are made without diaphragms, and that for the landscape distance is made with the smallest.

mercury-box from all emanations from the accelerating substances, have caused us to adopt it for all our apparatus, *of whatsoever size*, and whether made with one object-glass or with two.* One of the boxes is therefore made to contain a large mercury-box (fig. 8), with legs sliding in and out, as seen at *c d*; a thermometer, *m n*, and a yellow glass, *u v x*, to throw the light of a wax tapor on the plate, in order that you may look through the plain glass, *p q*, and observe the progress of the operation; the camera is in the same box and contains the two frames, with shutters back and front, the ground-glass, the box for plates, and two of the Claudet frames to keep the bromined plates apart.

Thus, when the operator wishes to take several photographic images during a whole day's excursion, he has only to take with him a certain number of bromined plates; then fill up the vacant space in the box with the lucifer-box, the bottle of mercury and the spirit-lamp. When it is considered that all these articles are contained in a *single box*, which locks up, and which is of no greater bulk than 9 inches square, and weighing less than 4½ lbs.—it will be admitted that what is called the daguerrian luggage is reduced to a very small compass. It must, however, be borne in mind, that we are here speaking of an apparatus of

* It has happened to many persons, and once to ourselves, to obtain no result with an apparatus throughout a whole day, because it had been shut up in the same box as the accelerating substances, which had saturated all the wood.

the 1-6th size; but, as the same arrangement exists for all the other sizes, with this improvement, even those are very different in point of size and convenience, to what they were formerly. Those who might not have sufficient confidence in the use of the plates bromined in the morning, previous to setting out, (in which they would be, however, under an erroneous impression,)* may place *temporarily* in the same box, in which they will find sufficient room, a buffing board, a small bag of rouge or tripoli, the velvet buff for the last touch, the iodine-box, the broming-pan, the fixing-stand, and the chloride of gold; so that if they take besides in their pockets a bottle of bromine-water, and another of hyposulphite of soda, they can go out for the whole day, and take portraits or views which they can *finish on the spot*, with the portable apparatus contained in the box, the dimensions of which are given above.

Now that we have described all the articles that are required to be kept separate from the chemicals,

* If the plates are of good quality, we guarantee that, when prepared by the iodizing process, and bromined in the morning, they will give, throughout the whole of the day, excellent results; if, notwithstanding this assurance, any doubts should remain, a fact, which we are about to mention, will convince the most incredulous. In a large establishment for portraits, in London, under the direction of Mr. Claudet, from thirty to forty plates are iodized and bromined every morning, as will be seen further on: these plates serve during the whole of the day, and if any remain, they are the first used the next morning; on some of those last, it is true, there does often exist some black specks, but only on a few of the number. On the other hand, Mr. Claudet is of opinion that they had acquired a greater degree of sensitiveness.

we shall give the list of those articles contained in each of the two boxes, which are of similar dimensions; these are :—

1st. The camera, with variable diaphragms, (fig. 6).
2nd. The mercury-box, with the yellow and plain glasses, and thermometer (fig. 3).
3rd. The ground-glass and frame.
4th. Two frames with shutters, with or without back-board.
5th. The plate-box.
6th. Instrument on which to polish the plate (fig. 1).
7th. Two Claudet-frames to keep apart the bromined plates.
8th. The brass stand, for fixing the picture without adjusting screw, (fig. 10).

9th. Iodine-box (fig. 4).
10th. Bromine-pan, with its ground-glass cover, (fig. 5).
11th. Spirit-lamp.—12th. Lucifer-box.
13th. Small bag of tripoli.
14th. Half a pint of the bromine-water of the standard strength.
15th. A bottle of saturated bromine-water, divided by lines into 40ths of a half pint.
16th. A large bottle of spirits of wine, with ground-glass stopper.
17th. A ditto of tripoli, with ditto.
18th. „ ditto iodine, „ ditto.

19th. A large bottle of oil, with ground-glass stopper.

20th. ,, ,, hyposulphite.

21st. Rouge for polishing, in a small phial with ground glass stopper.

22nd. Nitric acid in ditto, ditto.

23rd. A boxwood bottle containing the mercury.

24th. A large wide-mouthed bottle, containing the tripoli, with muslin over the mouth.

25th. A glass bottle containing the rouge for polishing.

It will be seen, by the list of prices at the end of this work, that we have classed our apparatus under two distinct heads. The five first articles just enumerated, are contained in the first; and, as is the custom with most makers, all the parts of the apparatus, and all the chemicals, are contained in the same box. Those under the second head, comprising all the other instruments, either with one or two object-glasses, have, in like manner with the new 1-6th size, of which we have just given a description, one box for the apparatus, and another for the chemicals. This description will suffice to give an idea of the apparatus of larger dimensions: in the latter, the accessory articles are nearly the same; only the different substances, being in proportionate quantities, the bottles containing them are of necessity larger.

We earnestly recommend those to whom a small additional expense is not an object, to purchase the

apparatus as arranged in two distinct boxes. They will be amply repaid for the increased price by the possession of an apparatus more complete, and especially more convenient.

Before concluding this Chapter, we must say a few words on our double object-glasses. The double object-glass for the quarter and half-sized plates, is represented at fig. 8: it comprises two object-glasses, *A* and *B*. The rack and pinion by which to arrange the focus is seen at *C*; *D E* is a glass reflector, with parallel surfaces, which can be adapted to the camera at will, to redress the image. *G* is a diaphragm, which is to be placed behind the second lens, but only when it is requisite to obtain views of very great sharpness: for the portrait and most other objects, it would be entirely useless, and would only lengthen the operation.

The construction of the object-glasses for the full-sized plates, and for those of 24 centimètres by 32, differs from the above only in the addition of a third spare object-glass, which is used instead of the one represented at *b*. This third object-glass, having a focus much shorter than the other, is used for portraits, and almost always without diaphragm.

We continue to use, for redressing the image, the parallel glass reflector *D E*; we have found by experience that it operates quicker than the rectangular prism, and that it gives as clear an image as the prism, whilst its cost is much less.

Fig. 9. A bath and drying-rack for large plates.

Fig. 10. Stand for fixing the impression with the chloride of gold; by means of the three adjusting screws at the base, the plate can be brought to a level.

Fig. 11. The portable travelling-stand for the camera, invented by Baron Seguier; the ball and socket at *a* allows the operator to give to the apparatus any direction he likes; the board *c d* unscrews, and the feet are jointed at *e*, *e*, *e*, so as to fold in two.

Fig. 12. A chair with a support for the head in taking portraits.

MR. CLAUDET'S APPARATUS.

The object Mr. Claudet has had in view in the different combinations of his apparatus, is to adapt it to operate with all sizes of plates and all kinds of object-glasses, whether with long or short focus, simple or combined. This form of apparatus is very convenient for those who wish to take alternately views and portraits on plates of different sizes, which renders it requisite to have lenses of different focus, and giving a more or less extended field of light. To take views or portraits on plates of small dimensions, it is advisable to use lenses with short focus; hence the necessity of having an object-glass adapted to each dimension of plate. It is therefore evident that every amateur, and even every one who practises with the daguerreotype professionally, will after all find it most convenient and economical to possess an apparatus constructed

on these principles. But there is another reason which strongly recommends it, and that is, that, every year, lenses upon improved principles are introduced, whereby the old apparatus are in a manner superseded. It becomes necessary, if one wishes to be on a par with other operators, to purchase new instruments; whilst, by Mr. Claudet's system, one can profit by all these improvements as soon as known, without having anything else to do than to procure the new optical improvement, or to have the one in use altered. In a word, for those who wish to follow this art without encumbering themselves with numerous apparatus, it is indispensable to give the preference to the one in question.

What therefore distinguishes this arrangement from those which had been followed previous to its invention is, as we have said, the facility of operating with all sizes of plates and with all kinds of lenses, without change of apparatus.

We shall now proceed to describe the construction of this camera, the frames destined to receive the various sizes of plates, the manner of operating, and the adaptation and changing of the object-glasses.

Fig. 13 represents the camera, into which a movable frame, *A B C D*, slides parallel with the sides of the box from one end to the other, by means of four ledges, *E F G H*, firmly fixed at each of the four angles of the frame. These ledges suffice to maintain the parallelism when the frame is moved to adjust the focus. This sliding-frame includes four

other frames, corresponding to the size of each plate, as made so to fit one within the other, and each bearing on the rabbet of the larger one. These frames are shown at fig. 14. When you wish to operate on large plates, take out such of the smaller frames as will leave you the sized frame you require, with its rabbet to receive either the plate or the ground-glass. Mr. Claudet operates with naked plates only. He iodizes, bromines, places them in the camera, and conveys them to the mercury-box, without ever fixing them in a frame, as is generally done. He has found that it was more convenient to operate in this manner, which is less subject to accidents and dust, both difficult to avoid when placing the plate in a frame and withdrawing it therefrom. The moment the plate is polished it is placed over the iodine and then over the accelerating substances. After this operation, Mr. Claudet puts the plate into a flat box with a lid, (fig. 16,) turning downwards the silver surface of the prepared plate. The plate is supported by slips of glass glued all round the box; these slips are sufficiently high to hinder the plate from touching the bottom, which is covered with glass. It would be well, before using this box, to be sure that it contains neither dust nor damp. Being entirely lined with glass, it is very easy to dry and wipe it with a linen cloth. The glass slips, or ledges, which sustain the plate, are cut off at one angle, to allow of raising the plate easily by pressing it with the finger at its opposite angle *a*. (See fig. 16.)

Mr. Claudet has adopted the use of naked plates for another important reason, and which he considers an essential condition for adjusting the focus; it is that of placing the ground-glass naked (that is to say, without being fixed in a frame) on the rabbet of the frame, which afterwards sustains the plate in the camera. It is evident that, even with the greatest care in getting up the apparatus, when two separate frames are used, one to hold the plate, and the other the ground-glass, it but very rarely happens that the plate and the ground-glass occupy the same exact position or distance from the focus of the object-glass. Even admitting that when the apparatus was purchased the two frames presented both surfaces exactly at the same distance, it is to be feared that, after the lapse of a certain time, the wood of each frame may have become warped different ways*.

We will now resume the description of the frames of the camera, which we digressed from to explain their use with naked plates. We have said that the frame A A A A, fig. 14, is intended for large plates; when it is wished to operate with plates of the half size, the frame B B B B, is placed upon the rabbet of the frame A A A A, it is fixed by means of a spring, and the frame C C C C, is added

* Mr. Claudet's system appears to us very rational; we cannot but approve of the precautions he has in view: however, for those persons who are accustomed to operate with plates fixed on frames, we can assure them that no frame, or other part of our apparatus, leaves our establishment without being thoroughly proved.

in like manner for the plates of the quarter size, and the frame D D D D, for the plates of the one-sixth size ; if it were wished to operate upon plates of other dimensions, it would only be necessary to adapt other frames of corresponding sizes.

To obtain the proper focus, a ground-glass of the size of the metal plate is put into one of the frames A, B, C, D, and maintained in its place by means of the two large springs E, E, which turn on a screw, and which are brought upon each end of the ground-glass ; then, after having unmasked the object-glass, the frame is moved forward until the image of the object is shown most distinctly on the ground-glass ; the stem K, L, is then firmly screwed on by turning the nob M. This operation forces in an outward direction the two bars or ledges F, G (fig. 13), and causes them to be pressed with force against the sides of the camera, which perfectly fixes the movable frame in the situation in which you have placed it in respect to the focus.

When this is done the ground-glass is withdrawn, and the prepared metal plate is taken out of its box in the camera, and put in its place. It is advisable to have a black cloth curtain hooked on to the opening of the camera, by which means the operator can take the plate from out of its box and place it in the frame without exposing it to the light. The plate is kept firmly in its frame in the same manner as was done with the ground glass, by means of two springs E, E. When the operation is finished, the two

springs are shifted, the plate being meanwhile upheld by the hand, and it is put back into its box to convey it thence to the mercury-bath.

The changing of the object-glasses adapted to each size of plate is performed by means of the board B, fig. 15, on which each lens is fixed, and which is adapted to the front A, A, of the camera; they are made to enter within two stops, *D*, *D*, and fixed with the screw C. Nothing is more easy than this change of lenses. Thus with a single apparatus it is possible to operate with all sizes of plates, with object-glasses adapted to each size. The camera may contain the mercury-box, the iodine-box, the lenses, &c., with another small box containing the chemical preparations distinct; the operator has thus in a convenient shape one single apparatus, by which are performed the operations of four instruments*.

* Just as this work was going to the press, Mr. Boquillon communicated to us an improvement which he proposes to introduce to Mr. Claudet's apparatus. Its principle consists in substituting for the four ledges, *e*, *f*, *g*, *h*, a box or case complete, occupying the whole of the interior of the camera, and fixed at the proper point by means of an external screw. This arrangement presents the advantage of enabling the operator to copy, in their natural size, engravings or other objects of small dimensions; as it is sufficient for that purpose to turn round the inner case so as to bring the frames *a*, *b*, *c*, outside, and by this means to double the distance betwixt the plates and the object-glass; a necessary arrangement for obtaining distinctly the image of objects at the focal distance from the object-glass.

CHAPTER II.

COMPARISON BETWEEN THE PROCESS FORMERLY IN USE AND THE ONE AT PRESENT ADOPTED.

It is certain that the application of the sensitive coating, by the use of the bromine-water at a given degree of strength, introduced by Mr. Fizeau, is not attended with the uncertainty which occurs in the use of other accelerating substances; and it cannot be denied that the first named preparation is infinitely more simple and easy. Now, that by the use of double object-glasses, we are enabled to operate with great rapidity, in case it is only wished to copy an edifice, some operators will confine themselves to Mr. Daguerre's method.* In our opinion the beginner would do well to practise the method pointed out by the master of the art; but in order that the uninitiated may by a single glance perceive the difference which exists between the two modes of operating, we will here give a succinct analysis of the old method, and then give, in contrast, an abstract of the system at present followed: these methods thus contrasted

* See the description of the Daguerreotype and Diorama, and the processes adapted to each, by Mr. Daguerre: Paris, 1839. Published by Lerebours, optician to the Observatory of Paris, Place du Pont Neuf, No. 13.

will give an insight into the working of the Daguerreotype processes to those who are, as yet, unacquainted with the art.

OLD METHOD.	NEW METHOD.
1. Rub the plate with oil, clean off the oil, heat the plate strongly, and polish it well with pounce or tripoli.	1. Polish the plate.
2. Apply a coating of iodine (of a golden-yellow colour.)	2. Apply the coating of iodine.
3. Subject the plate to the action of the camera.	3. Subject the plate to the vapours of the bromine-water or other accelerating substances.
4. Subject the plate to the action of the mercurial vapours.	4. Expose the plate to the camera.
5. Deprive the plate of its sensitive coating in the hyposulphite bath.	5. Subject the plate to the action of mercury.
6. Wash the plate with distilled water in a boiling state.	6. Deprive the plate of its sensitive coating in the hyposulphite bath.
	7. Fix the image by means of the chloride of gold, according to Mr. Fizeau's process.
	8. Wash the plate with filtered or distilled water.

CHAPTER III.

CHOICE OF THE PLATES.*

If the object-glass be the most essential part of the photographical apparatus, the plates are its most essential accessories. It is well known that the plates coated with silver, as well as all other plated works, must have stamped on them a number showing the quality of the silver, and the manufacturer's mark; the law *is positive in this respect;* but what many persons do not know is, that the order of the 19th of Brumaire, of the year VI. of the Republic, is not at all observed in practice. There exists in this matter, what, by common consent, has been called *toleration;* this toleration, (which was at first granted to the manufacturers, in order to throw no impediment in the way of their trade, by exacting from them the precise quality of the article they produce, which

* The plates are manufactured in the following manner:—A thin sheet of pure silver is laid on a much thicker sheet of pure copper perfectly flat, and both are enveloped in a sheet of thin copper; the whole is then subjected to a cherry-red heat. The adhesion of the two metals is facilitated by rubbing the upper surface whilst hot, with an iron roller; they are then immediately passed between two steel rollers turning inversely. This last operation (*the laminage*), reduces to extreme thinness the two metals, which are thus soldered, and brings the metal to the required thickness: nothing then remains but to cut the plates to the proper size and to planish them.

may vary by a small proportion in plated metal,) has been much abused, and—we ask pardon for the expression—the cause of a system of swindling. In this state of things, it was agreed to admit a plate containing 1-35th part of silver for a 30th part, a 25th part for a 20th, (this last case, we must admit, was much less frequent ;) at present it is no longer even thus : under favour of the toleration we are speaking of, some manufacturers more daring, and less scrupulous, have not hesitated to sell plates containing only 1-90th part of silver, for 1-30th, and even beyond that proportion ; and in order to screen their person, if not their honesty, from the strong arm of the law, they have omitted to mark the plates with their private mark. It has come to this! The excuse by which such a fraudulent practice is sanctioned, is that of maintaining the *interests of the French manufacturer*. It is pretended that, as many governments do not oblige their subjects to mark their plates according to the real quantity of silver they contain, the French cannot stand against the competition, except by pursuing this course. And thus it is, that plated articles marked as if containing 1-10th of silver, contain in reality but 1-60th.* The

* This abuse reminds me of another, which I may be excused for citing, although quite foreign to my subject, because its existence tends, as well as that of the first, to depreciate the products of French industry in the eyes of foreigners.

In all the French sea-ports, there are to be purchased almost all the instruments necessary for navigation. Thus, a great number of telescopes may be met with in those places : *in some,* these articles are offered

result has been, that the French makers, who might have monopolised the trade in these photographic plates, have already in the English formidable rivals. Is it not grievous to see a new branch of industry thus impeded, and perhaps entirely lost to France, because one or two manufacturers have been too covetous?

But to return to our subject: the plates should only be purchased of a respectable firm. However, we advise those who wish to make use of them, to have them tried. This kind of article passing, as it does, necessarily through different hands, too much care cannot be taken in examining it.

To obtain plates which will admit of being re-polished a sufficient number of times, even after having been fixed, it is necessary to choose them of a

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to the buyer, having engraved or stamped on them the names of English, a few of French makers; but the greater number, though of French manufacture, are without any name to them. If you examine these different telescopes, you will be surprised to find that those only are good which are marked with an English name, and that in those of the second and third descriptions above-mentioned, not even a tolerably good glass is to be found. And yet they are offered you as the most perfect that can be manufactured by the best French makers. For a person who is in want of a good telescope, there can be no hesitation about the price. Such a one, therefore, buys a glass marked "*Dollond*," and then goes about repeating that there are no good telescopes but those made in England.

The explanation of this fact is as follows:—All these telescopes are most frequently the production of the same French maker; only the latter, after having sorted them into classes, gets engraved on the best the name of an English maker, which enables him to sell them much dearer. As to the others, he marks them at a very low price; but as few purchasers like to buy an inferior article, it does not matter much to him.

quality not less than that of 1-30th of silver. In the portrait department of our establishment we formerly made use of no plates of a quality inferior to that; but for some time past, in imitation of Mr. Claudet, who has informed me that he only uses, in London, plates containing 1-10th of silver, this last proportion is not only used for a great number of portraits executed by us, but also exclusively for all experiments. Beginners, and those who wish to make experiments, will effect a considerable saving by using such plates.

Good plates have a strong metallic lustre; they are without specks, &c., and the slightest trace of copper should cause any plate to be rejected. A slight line or slight scratches are no obstacle to obtaining a fine impression, provided always those scratches do not reach the copper; and care must be taken when operating for a portrait, to place the head upon the part of the plate which is free from imperfections.

CHAPTER IV.

POLISHING OF THE PLATES.

It would take a volume to describe all the methods that have been suggested for the polishing of the plates. We shall confine ourselves to the following description, which is an exact summary of our mode of operating. The manipulations which we subject the plate to, differ essentially from those which we gave in our last edition ; several of them are the result of our own experience, and some, amongst the most important, have been communicated to us by Mr. Claudet.

The new plates, and those having the impression fixed on them, require a longer process in cleaning than the others. For new plates, it is necessary, in the first place, to efface the traces of the hammer and the dust resulting from the planishing ; for plates which have had an impression fixed on them, it is necessary to bare the silver, that is to say, to take off the impression which had been fixed by the chloride of gold. When the plate is placed on the polishing-board, it should be powdered over with very fine emery, then add some drops of very pure olive oil, then with a pledget of cotton it is rubbed with this paste in a circular direction, during a space of

from five to ten minutes, and the same operation is repeated two, three, or four times, or even more, according to the state of the plate. As the emery forms a substance which lodges itself in the smallest cavities of the plate, the attention of the operator must be directed, in all the subsequent processes, to fetch it out of these small cavities, the importance of which will be evident to him, since it is impossible to obtain good impressions if the plate be not perfectly clean and highly polished. After the plate has been well wiped, no traces of the planishing should appear, and its surface should be perfectly even and smooth; when this state is attained, the plate should be rubbed with tripoli, which is softer than emery, and will prepare the plate better to receive the last polishing, which will be accomplished without difficulty, provided the plate has been prepared in the manner described.* This last operation, the final polish, is begun by wiping the sides and back of the plate with perfectly clean cotton, then fix it on the plate-board, previously freed from all grease by washing it with spirits of wine, or by placing it on another polishing

* The reader will see that in this process the plates are not heated; this last process, which wears them considerably, is only necessary in case they are stained with mercury. In regard to the polishing with oil, which a great number of persons now dispense with, we think that it *may be entirely dispensed with in respect to the small plates; and we have substituted for it, without any disadvantageous effects, a similar number of polishings with spirits of wine.* Amongst the most beautiful proofs we have ever seen, are those of a distinguished amateur, Mr. Eynard, who has entirely excluded the use of oil from his preparations.

board kept entirely for that purpose, which last method is preferable; then powder the plate with tripoli, and dip a knot of cotton very slightly into a mixture composed of spirits of wine and water,* and then rub the plate lengthways† until it becomes entirely dry. Repeat a second time the same operation, only using rouge instead of tripoli, when the defects which may yet exist will be rendered apparent by breathing on the plate.‡

A great number of persons powder the plate, *very slightly*, with rouge, and, with a fresh piece of cotton perfectly clean, rub it for a few seconds longer, in order to deprive it of any remaining dampness which might exist on the silver after the application of the spirits of wine; others, with the same intention of

* In winter, spirits of wine may be used without inconvenience; but, during the extreme heat of summer, it evaporates with great rapidity, and sometimes does not even give time to cleanse the surface of the plate from all greasy particles. Water slightly acidulated may be used instead, as Mr. Daguerre has directed: however, as alcohol has constantly given us excellent results, we prefer it. Moreover, Mr. De Nothomb has proved that the addition of a small quantity of caustic potassium to the spirits of wine, gives to the impression a superb tone of colour.

† That is to say, from left to right, but in a direction parallel to the edges of the plate; bearing in mind, however, that the polishing must always be parallel to the horizontal lines of the image *that is to be produced.*

‡ In order to be certain that the essential conditions prescribed have been fulfilled, and that the plate is therefore in a fit state for the iodizing process, it should be tried by breathing on it. The dull vapour from the breath should disappear simultaneously from the whole surface of the plate, and the breath will then render apparent, under the form of whitish lines, the defects caused by the particles of dust, &c., contained in the cotton; a small spot of saliva, or the remains of damp on the plate, would show traces of an opposite kind. The traces of mercurial particles will at first have this same appearance, but soon after they will assume that of a dead white.

perfectly baring the silver, confine themselves to rubbing the plate rather briskly with fresh pieces of cotton wool only. This method is not bad, but it requires cotton entirely exempt from grease, which it is difficult to obtain, and for this reason we prefer the first; with either method it is, however, necessary not only to use very fine cotton, but also to take care to pick out of it all the small grains and particles of dirt, which it always contains in greater or lesser quantity; for a single one of these particles would suffice completely to spoil the plate, just at the moment of the polishing being perfected, and would compel the operator to begin his work anew with alcohol and tripoli.

The operator cannot be too particular to use the greatest cleanliness in all these last operations; the plate should be often wiped, and the cotton handled with the greatest care, and in such manner that the fingers never touch that part of it which is afterwards applied to the plate.

The last two operations, which we have just described, give to the plate a tolerably good polish; but it is very inferior to that which is obtained by going through the process hereafter described, which Mr. Claudet has been kind enough to make us acquainted with.

Take a piece of white cotton velvet, previously freed from grease by steeping it for an hour in a new vessel containing boiling water; dry this velvet without touching it with the fingers, then cut it to the necessary size, and fix it with tacks on a wooden holder

(see fig. 2), after having placed between the velvet and the wood, one or two layers of cloth to increase the softness. Then powder it over with a very small quantity of rouge, and rub the plate for a few seconds in a circular direction; and, to complete the operation and give what we call the *finishing touch*, rub the plate lengthways in the direction of the polish you wish to obtain (see page 26): by this operation the plate acquires a black polish of the greatest possible beauty.*

When the plates are finished in this manner, they may be placed (if intended for use the same day), immediately over the iodine box, and that would indeed be the best way. The elevation of temperature produced by this last polish, causes the plate to become iodized much sooner, and its combination with the silver of the plate is thereby rendered more perfect.

When they are to be kept several days, they should be put by in the plate box, or better still, placed two by two, with the Claudet frames (fig. 3) between them, and wrapped up with the greatest care.

This is the proper place to mention the last communication made by Mr. Daguerre to the French Institute. He therein points out, as will be seen hereafter, certain processes which have the effect of giving to the plate a double degree of sensitiveness. It will be easily imagined that we were eager to try a process which promised such results; and we were

* A similar velvet buff may also be advantageously employed for the cleaning with oil; but you must keep one in reserve very clean, and entirely exempt from dust and greasy particles, for the finishing touch.

the more ardent on the subject, as the method explained by Mr. Daguerre seemed to us, not only very rational, but likewise to add but little complication to the operation; unfortunately, notwithstanding our most strenuous attempts at success, experience has proved to us that, at least for the large sized plates, success will be very uncertain; and we are led to this conclusion by the fact that, if on the one hand, it be incontestable that the boiling water extracts from the silver surface all the impurities which it contains, it seems to us that the grease on it, if any exists, cannot be dissolved in distilled water, as it would be for example in alcohol, which last would offer the same difficulties of execution, and the use of which, besides, would not be unattended with danger: the first difficulty which presents itself, is the great nicety required in causing the water to run off the plate by the action of the flame of the spirit-lamp; the second difficulty, which will always be an obstacle in almost all places, is that the distilled water procured from different manufacturers of chemicals is not sufficiently pure, and always leaves behind it, as it withdraws from the plate, some minute particles of dust or of organic matter. Notwithstanding, other operators, more persevering than ourselves, may succeed better than we have done; and we therefore subjoin the process as it was communicated by Mr. Daguerre to the French Institute.*

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* *On a new process for polishing plates destined to receive photographic images; a process by which may be obtained perfectly identical*

Although many persons have had a doubt on the subject, it is perfectly true that Mr. Daguerre has discovered the means of producing really instant-

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results, as long as the external circumstances remain the same. (*Letters from* Mr. Daguerre *to* Mr. Arago.)

"Since the publication of my process, I have not been able to attend much to it. The investigations into which I have been led, have carried me into a route totally different; and the experiments which they render necessary, have no other analogy with the preceding ones, than inasmuch as that they are also performed upon a metal plate. However, I have been of late so much struck with the unequal results which are in general obtained in the images, even when the experiments are performed by persons who make a special study and occupation of the art, that I resolved to seek a means to remedy this serious inconvenience, which I attribute to two principal causes:—

"The first cause relates to the operation of polishing, which it is physically impossible to accomplish without leaving on the surface of the plate traces of the liquid and of the other substances employed in this operation; even the cotton which is used,—however clean it may be in appearance,—suffices to leave a film of dirt upon the silver. This first cause constitutes, alone, one very great obstacle to the success of the operation; because it retards the photogenic action, by hindering the iodine from coming into immediate contact with the silver.

"The second consists in the changes of temperature in the atmospheric air, with which the plate is in contact from the first operation, to that of the mercury. It is well known that as often as bodies, when co'd, are exposed to a warmer air, the humidity contained in it is condensed. It is to this effect that we must attribute the difficulty experienced in operating in a moist air, such as the atmosphere is, especially when you come to the operation of the mercury, which requires, to give out a proper vapour, a heat of at least fifty degrees centigrade.

"This vapour, which begins by heating the air contained in the apparatus, produces on the metal a mist which weakens the impression. It is very evident that this moist coating is very injurious; if for example you breathe several times on the plate, when it is taken out of the camera, the mercurial vapour will not bring out the image.

"The vapour, which becomes condensed *even at the slightest difference of temperature* between the surface of a body and the surrounding air, contains in suspension a non-volatile substance, which might be called the

aneous impressions; that is to say, the horse at full gallop, the bird on the wing, the wave in motion, &c. But, unfortunately, these impressions are faint and

atmospheric deposit; and, as soon as an equal temperature is established between the air and the surface of that body, the humid vapour which had condensed upon it becomes volatile, and, depositing upon it the sediment which it contained, mixes with the air and becomes again saturated with a new quantity of that impure substance, the deposit above named.

"In order to paralyze as much as possible this effect, the temperature of the plate may be kept higher than that of the air which surrounds it, during each of the operations. But it is not possible to carry this heat to fifty degrees, so that it may be at the same degree as the vapour of the mercury, because, if the plate is exposed to that degree of heat, after it has been subjected to the operation of the light in the camera, the image would be obliterated, or spoilt.

"At first, I had attempted to absorb the humidity of the air in the mercury box, by the means usually resorted to for that purpose, such as lime, &c.; but these means proved insufficient, and only complicated the process, without giving any satisfactory results. Another means which has been proposed consists in vapourizing the mercury in the pneumatic machine; by this process, it is true, the mist on the plate is avoided; but the plate is thereby deprived of the pressure of the air which is indispensable to the formation of the image. Results thus obtained are never free from imperfections.

"The following is the process which I have at last fixed upon, because it is very simple, and obviates the two obstacles to success, which I have pointed out above; that is to say, that it clears as much as possible the silver surface of all impurities or atmospheric deposit, and that it neutralizes the moisture produced by the increased heat in the mercury box. By the first of these two effects it augments the rapidity of the operation; and, by the second, it renders the lights of the picture much whiter (especially after the application of the chloride of gold of Mr. Fizeau); these two effects are always certain. The rapidity attained by this process is to that obtained hitherto, as three to eight; this is the exact proportion between the two methods.

"My process consists in floating the surface of the plate, after having polished it, with very pure water, and then heating it to a high degree with a spirit lamp, and afterwards to pour off this layer of water in such a manner as that its surface, on which the sediment which it has raised floats, shall not touch the plate.

clouded; those who know the persevering spirit of Mr. Daguerre will not be surprised that he should have withheld this discovery, though so very extraordinary a one, before having brought it to perfection.

Mr. Fizeau admitting, as a general principle, that the modification of substances which are impressionable from the agency of light is proportioned to the intensity of the radiations, and to the time during which they are subjected to them, drew from

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" *Manner of operating.*—Use a wire frame of the size of the plate, with a handle at one of its angles, and, in the middle of two of its opposite sides, two little catches to hold the plate when in an inclined position. After having placed this frame horizontally, put the plate upon it and cover it with as much water as the surface can contain. The plate is then strongly heated underneath, when very small globules or bubbles will be formed on the surface. By little and little these bubbles become larger and at last disappear; continue to heat the plate underneath until the water boils, and then make the latter run off. The process of drying the plate is performed thus: begin by holding the lamp under the angle of the frame at which the handle is fixed; but, before raising the frame, this angle must be well heated, and then, by raising the plate up a very little by means of the handle, the water begins immediately to run off. The operator must manage that the lamp should follow under the plate the sheet of water in its progress, and to incline the plate but a little at a time, and just enough, so that the water in running off lose none of its thickness; for, if it happened that the water dried up, there would remain some isolated drops which, being unable to run off, would cause spots in drying, since they would leave on the silver surface the sediment which they contained. After that, the plate must not be rubbed again, for pure water does not affect its polish.

"This operation must only be performed when about to iodize the plate. While still warm, it must be placed immediately in the iodine-box; and, without letting it cool, it must be subjected to the vapour of the accelerating substances. Plates thus prepared may be kept a day or two, (though their sensitiveness diminishes a little during the time,) provided several plates so prepared are placed face to face, at a very small distance from each other, and carefully wrapped up to avoid the renewal of the atmospheric air between them."

it this conclusion, that if, instead of operating with the camera, with a sensitive coating carefully prepared out of the influence of these radiations, we were to operate with a coating already slightly impressioned, nearly to the degree at which it would become visible when subjected to the action of the mercurial vapour, (which effect may be obtained by means of a lamp with a uniform light,) the photographic image will be obtained in less time; and, moreover, the effects of light and shade will not be the same—that is to say, that the relations between the intensities of the different parts of the image will be changed.

To render this perfectly clear, let i and i' represent the intensities of two points of the luminous image; if you operate with a coating which has not been impressioned, the alteration of these points will be in proportion with the objects which have produced them; and the relation between the degrees of alteration will be $\frac{i}{i'}$.

But if you employ a coating already uniformly impressioned, it is easy to see that this is equivalent to adding a constant quantity of light to all the parts of the luminous image; consequently, if we call this quantity of light a, the relation will become $\frac{i+a}{i'+a}$, which relation tends towards unity in the ratio in which a increases.

The difficulty of causing the sensitive coating to become impressioned by a uniform quantity, is the only difficulty that attends this method.

CHAPTER V.

ON THE IODIZING OF THE PLATES.*

We have given a description of our iodizing boxes at page 2; we will only add here for the information of those who have apparatus of different dimensions, that they may confine themselves to a single iodine box; but in that case they must have a piece of plate-glass in the shape of a square, which will be found in the apparatus of Claudet, and they must adjust it so as to give a proper space for each size of plate.

When it is wished to iodize the naked plate, use the varnished frames which fit each of our square pans, and the plates.

If the plate which is to be iodized has just been rubbed with the velvet buff, of which we have spoken in the chapter on polishing, no dust will remain on it, and a slight puff of the breath will take off the few filaments of cotton which may have remained on its surface. If the operator has no buff at hand, he will draw a tuft of cotton from the bulk, and must pass it very slightly over the whole surface in the direction in which it is polished; this operation will clear the plate of all the fine particles of dust often invisible to

* Iodine appears in the form of small scales of a bright metallic lustre and of a leaden colour, and has a most disagreeable smell, and dyes the skin yellow. It is produced from the ashes of a plant found on the sea-shore.

the naked eye, and which would not fail to cause the impression to be speckled all over with minute black spots.

The plate being thus brought to the required state of polish, it must be placed over the iodine-box, and after being subjected to its fumes during a few seconds its colour should be examined, and if it be perceived that it assumes more colour on one part than on another, it should be turned round without fearing in the least the action of the light; and to obviate the effect which would arise from the iodine being accumulated in certain parts of the cotton, it must be more uniformly distributed, or else entirely changed.

Each time that the frame holding the saturated card in the iodine-box is turned, care must be taken to wipe with fresh cotton the sides of the frame and the surface of the slips of glass which line the card-frame; you will thereby avoid the tendency which the iodine has always to deposit itself more strongly towards the edges of the plate: this effect can be also remedied by accumulating in the middle of the cotton a larger quantity of the particles of iodine.

The most convenient method for appreciating correctly the colour of the plate, is to reflect upon its surface a piece of white paper; when the plate has attained the most proper tint,* the paper examined thus by reflection in the plate must

* It is true that our large plates, fixed upon their curved plateboards, will acquire a rather darker tint towards their curved edges than on the rest of the surface; but, at the same time, the bromine will fix itself in larger

appear of a very dark yellow colour,* beginning to assume, but in a very slight degree, a rosy hue.†

quantities on those same parts ; so that the result will be, that the sensitiveness of the plate will, after all, be *very nearly the same* all over the plate ; and then this slight difference, moreover, will be very advantageous to the effect of the picture ; and every one who is anything of an artist will immediately apprehend our meaning. Experience proves that the impressions iodized to a *rather light yellow gold tint*, and brought by the bromine to *a very light rose-colour*, have their white parts very intense, and their deep shades very black. It is also known that if you employ a thicker coating of iodine, and apply upon it a proportionate tint of bromine, so as to obtain a *deep rose* tint, the oppositions will be less marked, and the image have a softer tone. This effect has been obvious to every one who has practised the art. The results, therefore, of the curve given to the plate, are, that the furthest parts, or those nearest the border, are more harmonious, and that all the effect is thereby reserved for the centre ; and this is precisely one of the laws followed by all good artists.

* In like manner as is the case with thin laminæ of air, so all transparent bodies, deposited in excessively thin layers, reflect colours which vary according to the thickness of these strata. We may lay down as a general law to which they conform the following order, which it will be seen has more than one relation to the prismatic colours : a *yellow* straw colour, a dark or *orange* yellow, a rose colour more or less dark in tint, or *red*, violet, steel *blue*, and *indigo* (these last two are nearly the same) ; and lastly, *green*. After attaining this last-named colour, the plate re-assumes a light yellow tint, and continues to pass successively a second time, with the exception of some alterations, through all the shades above mentioned.

† We have pointed out this shade because it is that which suits best with the use of the bromine-water. Doubtless a plate which has been iodized to a very light yellow tint, or even to a violet hue, may in some cases, after having been bromined *in proportion*, give a very fine picture ; but we were bound to indicate the most favourable conditions for success.

Mr. Buron is one of the first who have pointed out this tint.

CHAPTER VI.

ON THE USE OF THE BROMINE-WATER.*

We have already said that we do not exclusively confine ourselves to one method of polishing; neither do we to the choice of the accelerating substance. However, if our opinion were required, we should say that we prefer the bromine-water, at a proper degree of strength, to any other mixture; this preference is founded on its uniform action, and on the facility with which it *always gives, without any second attempt, the maximum of sensitiveness.* Doubtless the bromide of iodine, and many other compounds, may often produce as fine results; but how many fruitless attempts must not be made before obtaining this grand desideratum of the maximum of sensitiveness! and how much care is not necessary, in order to preserve it for several days, after having succeeded in finding it! †

We have considered it advisable to insert in this

* Bromine is a red liquid, very volatile, and in the highest degree deleterious; it is extracted from the water of salt-pits, after all the salt has been withdrawn. It is on account of the great analogy which exists between this substance and iodine, that the idea of using it for the daguerreotype had its origin.

† We must, however, except the Hungarian mixture, of which we shall speak in the Third Part of this work.

edition the excellent notice made by Mr. Fizeau on the use of the bromine-water.*

The reader will find in it some indispensable advice for those who wish completely to understand the photographic phenomena.

The square flat pans, of which we had only proposed the use with a certain degree of hesitation in our last edition, having been generally adopted, we shall not enlarge upon the advantages that attend their use, nor upon their extreme simplicity. We add to each of these pans a varnished frame, by means of which the plate is used.

We recommend the use of the marked bottle containing the saturated bromine water,† which will be found in each of our apparatus for preparing the standard or normal bromine mixture. They will be found an advantageous substitute for the glass tubes, which are so liable to break, and difficult to use.

Each division marked on these bottles corresponds with *one-fortieth part* of the bottle destined to contain the normal bromine water. It will, therefore, suffice to pour into the bottles which are to contain the weaker solution (after having first very nearly filled them with water), ‡ the quantity of the saturated liquid

* The reader will find, in the Third Part, the composition and use of all the other accelerating substances.

† This solution is prepared by shaking well in a bottle, nearly filled with pure water, so much bromine as that there shall remain, after the whole has been well shaken, an excess of bromine at the bottom of the bottle.—(For more ample details, see Mr. Fizeau's Notes, Chapter XVIII.)

‡ Mr. Fizeau has found that it is indifferent whether you use spring or

contained between each of the divisions marked on the bottles containing the last-named mixture; and by this simple method, the operator can always have a solution of the normal water, *i. e.* a mixture of the required strength of one-fortieth of the saturated solution.*

The manner of using the bromine water is as follows:—Make an opening at one of the angles of the square bromine pan, by pushing aside the sheet of glass which covers it, and pour in enough of the normal bromine water to cover the bottom to the depth of two or three lines.† The glass must then be immediately replaced in order to prevent evaporation; after the interval of a few seconds the plate, ready iodized to a *deep yellow colour*,‡ must be placed

river water, provided five or six drops of nitric acid are added to it for each quart. (See his Notes, Chapter XVIII.)

* We have adopted the proportion of *one-fortieth* of bromine water, because, having made use of bromine water at the strength of a thirtieth with our pans, the time of exposition, during the heat of a summer's day, was so short as hardly to give time to count a few seconds. This inconvenience, which, however, is only such on account of the accidents which infallibly result from operating with too much haste, is removed by adopting the use of the bromine water, at the degree of a *fortieth*.

† In order to obtain perfectly identical results, you must pour each time into the pan exactly the same quantity of bromine water; it might, therefore, be poured out into a very wide-mouthed bottle or jar, which will serve for a measure; or, still better—not to incur a double evaporation—introduce into the bottle the thin tapering tube of a strong glass syringe, upon which may be marked lines made to correspond with the quantity the pan will hold; or, best of all, and that is what we do ourselves, make marks on the bottle of normal bromine water, dividing it into equal parts.

‡ If the plate be iodized only to a light yellow, the results might be of a blueish or grey tone.

over the bromine pan and instantly covered over with the glass. The time during which the plate should be exposed to the action of the bromine water must vary according to the distance between it and the bromine water in the pan; but with our different sized pans that duration is comprised between twelve and forty seconds. It will, moreover, be easily understood that five or six experiments suffice, if carefully made, to determine invariably, and once for all, the time necessary for each sized plate; and, as this solution is easily made of exactly the same degree of strength, it should be changed at every successive operation. Great care must be taken that the light do not fall on the plate when withdrawing it from the bromine pan to place it in its frame.* To avoid this, it is advisable to place the frame on the table near the bromine pan. It is, therefore, impossible to fix exactly the time during which the plate must be exposed to the action of the bromine water; that depends on the quantity poured into the bromine pan. The temperature of the atmosphere has also some additional effect, but it is so slight that it need not be heeded. In general we have found that by

* Practice will alone show the modifications to be made in the time during which the plate should be exposed over the pan with the same solution of bromine water. This method, however easy, will always be attended with uncertainty; we therefore earnestly recommend that the solution be changed for each impression, otherwise it would be better to abandon at once the use of the bromine water, and to operate from the colour of the sensitive coating, as is done for the bromide of iodine, the Hungarian mixture, &c. (See Chapter XVIII.)

covering the bottom of the pan with a little more or less of the prepared bromine water, of the aforesaid proportions of *one-fortieth,* in various degrees of temperature, the following number of seconds were sufficient for the operations, viz.: for plates of the one-sixth size, 10 to 15 seconds; for the quarter size, 15 to 20 seconds; for the half-size, 25 to 35 seconds, and for the full or normal size, 40 to 50 seconds.

It will be easily understood that, with a given quantity of bromine water of the same strength, excepting under the influence of an *excess of temperature* of heat or cold, the results must be *identically the same.*

CHAPTER VII.

EXPOSITION OF THE PLATE IN THE CAMERA.

There are different methods of using the camera to obtain a photographic impression. Thus, for example, by one method, you must, after having chosen the most favourable point of view, by examining the manner in which the image is portrayed on the ground-glass, leave the stand in its place, carry the camera into the dark room in which the broming process is performed, place the plate, now covered with its sensitive coating, with its frame in the camera, which bring back and place on its stand. It is needless to say that the camera must be firmly fixed or screwed to its stand, and that it is necessary to ascertain, with the greatest exactness, before beginning the operation, either by means of the rack, or by the observance of the adjusting lines on the sliding frame, that the image is perfectly distinct. If you make use of a table, trace lines upon it, which will serve to place the camera exactly on the same spot. The operator must exercise himself in working without the help of the ground-glass, and habit will enable him to discover immediately whatever there may be unsightly in the position of the person or object; in like manner he will learn how to govern his apparatus, so that the head may be represented

on any particular part of the plate at will; for that purpose it is only necessary to direct his sight by the two upper projections of the box, and to bring within an equal distance from these projections, the object which is to occupy the middle of the picture. In order to determine the inclination of the camera, you must operate in a manner exactly similar.

Another method which is adopted by many persons is as follows: they begin by placing their apparatus in a proper position, and when they have brought the object to show well on the ground-glass, they withdraw the latter and put in its stead the frame which bears the plate. The slide must be opened with great care, so as not to put in motion, by a jerk or a strong current of air, the dust contained in the camera;* after that uncover the object-glass till the required time has elapsed for producing the impression. It is at this juncture that a real difficulty exists for beginners; as nothing is visible, it is impossible for them to determine with exactness the time that the plate should remain in the camera, but with a little practice they will be able to appreciate it correctly. It will be remembered that the time during which the plate

* To avoid these particles of dust, which produce a quantity of black specks on the image, you must take care to well wipe the inside of the camera as well as all the grooves and ledges. If, intending to take a view or landscape, you carried out with you several prepared plates in their frames, you must wrap them up in a cloth containing in its texture no particles of dust, such, for example, as an oil-skin, and by following the directions that we have given above for opening and shutting the slide, you will avoid those little spots which are sufficient to deprive a good impression of all its value.

must remain in the camera, mainly depends on the intensity of light acting upon the object to be reproduced; thus, in the south of France, in Italy, or in Egypt, the operation can be performed, all other circumstances being the same, much more rapidly than in the north; you must also take into account, with the same apparatus and the same sized opening of diaphragm, the colour of the object to be reproduced,* and the *colour* and *intensity* of the solar light.† If the apparatus and the diaphragms are dissimilar, you must add to the causes of uncertainty alluded to, the difference resulting from the disproportion of focal length and the openings of the diaphragms.‡ All this seems, at first sight, very embarrassing, but in reality the difficulty can be overcome by making a few experiments, and becoming acquainted with the working and powers of the apparatus used; and when once an operator has acquired a little experience and

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* All colours are not equally photogenic : thus, the chrome yellow, the P. Veronese green, and vermilion, three of the most brilliant colours of the painter's pallet, have hardly any action upon the sensitive plate; the blues, violets, and lakes, have, on the contrary, a very energetic one. We have made, on this subject, a great number of experiments, which we shall probably publish later.

† The photogenic intensity decreases in a very considerable degree in proportion as the sun approaches the horizon. Thus, on a fine summer's day, with a cloudless sky, at noon, a fraction of a second will only be necessary with our one-sixth size apparatus and single object-glass, to produce a picture; whilst at six o'clock in the evening it would take three or four seconds, and at seven, when objects are still glowing in the warm light of the setting sun, it will take not less than from fifteen to twenty seconds.

‡ And even then we do not take into account the greater or less degree of the sensitiveness of the plate, which, however, will vary but very little if the method pointed out by Mr. Fizeau be strictly followed.

a perfect knowledge of the apparatus in continual use, he will almost always succeed in judging at once of the time during which the plate should remain in the camera.

We give in the following table some *indications* on the duration of the exposition with different apparatus :—

STATE OF THE ATMOSPHERE.		DURATION OF THE EXPOSITION.				
		With Plates, 1-6th.	With Plates 1-4th.	With Plates 1-half.	With whole or Normal Plates	With Plates. cm. 24, by cm 32.
		Seconds.	Seconds.	Seconds.	Seconds.	Minutes.
With a sky veiled by slight white clouds.	The apparatus turned towards the north . . .	2 to 4	10 to 15	15 to 20	20 to 50	½ to 2
	Towards the south . . .	1 to 2	5 to 10	10 to 15	15 to 30	20 to 60
On an open terrace . . .		1 to 2	5 to 12	10 to 20	20 to 40	h. h. 1 to 1½
With the object illumined by the sun		a fraction of a second.	1 to 4	3 to 6	6 to 10	s. s. 15 to 20

In the event of a first attempt failing, the operator should make another immediately, and he may be almost certain of succeeding in this second trial. The following are some indications by which the operator will know whether he has left the plate in the camera too long or too a short a time. The exposition will have lasted too long, and the impression will be completely *burnt* or *solarised*, when all the objects reproduced are apparent, but with an inverse intensity to that which they had in nature; that is to say, that the whites have become blueish, and those parts

which should be black are more or less approaching to white. It will be known when the plate has not remained sufficiently long, when those objects *only* which have received most light are reproduced *very distinctly*, and when the other objects appear indistinctly traced, and too dark, or else not at all apparent. This differs, as the reader will see, from what has been published and repeated several times, and which is to this effect: "If the plate has not been subjected long enough to the action of light, the impression will be vague, and its outlines faintly marked, the details indistinct, *and the image, as it were, covered with a veil.*"

When you have shut out the light, take the same care in withdrawing the plate from the camera as was formerly recommended for placing it there, and convey it thence to the mercury-box.

CHAPTER VIII.

EXPOSITION TO THE MERCURY.*

The mercury-box should be kept, if possible, in a perfectly dark room; and in any case, the front of the box, in which is inserted the piece of plain glass, must be kept in an opposite direction to the light.

The plate having been put into the box, the mercury must be heated with the spirit-lamp until the thermometer rises to about 45 degrees centigrade;† the lamp is then withdrawn, and the thermometer will continue to rise to about 55 or 60 degrees.

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* Mercury is found in a natural state as a liquid in a red stone called cinnabar; it is known by the name of quicksilver: quick, because if thrown on the ground, it becomes separated into small particles, which run about every way; and silver, on account of its resemblance to that metal in colour. It acts upon gold and silver; it must not, therefore be touched with rings, or any other articles made of those metals. If by accident a ring were stained with mercury, it should be heated, and the mercury would go off in vapour. If the ring were even completely destroyed, the mercury should be taken care of, as it is possible to separate from it the precious metal, which still exists in the mercury, and has only lost its form.

† We have recommended the use of the thermometer only for beginners. A little experience will easily enable the operator to appreciate the proper degree of heat. He should apply his hand under the mercury-cup as soon as the lamp is withdrawn. If there is but a gentle heat, he must apply the lamp again for a few seconds. The most proper degree of heat, in our opinion, is that at which the hand feels the cup sufficiently hot to be unpleasant to the touch if kept in contact with it, but yet not so as to burn it. Several persons are in the habit of heating the mercury before placing the plate in the box; this method is not a bad one, but we have found no particular advantage in its use.

After the plate has been exposed to the action of the mercury during the space of a few minutes, the operator may, by placing a wax taper close to the yellow glass, *u v x*, fig. 8, and after having lifted up the black cloth *r s*, look through the white glass *p q*, and watch the formation of the image. When the mercurial vapours have produced their effect upon the image, which takes place in about ten minutes, heat a second time in the same manner; and according to the appearance it has, this operation may be repeated three or four times; the impression will improve a great deal by being subjected a considerable time to the action of the mercury. However, as soon as you perceive that the darker parts assume an ashy hue, no time must be lost in withdrawing the plate.*

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* The exposition of the plate to the mercurial vapours is only a question of time, for if you leave during an hour or more, in the mercury-box, plates for which it would have been necessary to apply heat several times, the result would be just as good. Mr. Claudet has, besides, proved that, in the pneumatic machine, at a temperature of 10 degrees centigrade, a plate is perfectly mercurialised in a quarter of an hour. †

† Different preparations have been pointed out as substitutes for mercury, which is difficult to carry about, and the contact of which is so injurious to the silvered plates.

Mr. de Brebisson proposes to confine the mercury in a linen bag of close texture, which is placed in the cup, and then apply heat in the ordinary way.

Mr. Charbonnier wanted to substitute for the mercury the ammoniacal nitrate of mercury.

Mr. de Nothomb, whom we have already had occasion to mention several times, has obtained, to our knowledge, some very fine impressions with calomel, which is a protochloride of mercury. He made known that process to the Institute in 1842.

Mr. Soleil and others have employed various fusible alloys; but all these methods are now abandoned by the greater number of operators.

CHAPTER IX.

ON THE HYPOSULPHITE WASH *.

In the greater number of pamphlets hitherto published on this subject, the proportion of hyposulphite recommended as necessary was much less than that really required. Many operators have applied to us to know what could be the cause of those numerous bluish and milky spots which appeared when the plate was fixed by the chloride of gold. It is our opinion that it is unnecessary to decide upon a fixed proportion, and that there may be an excess of hyposulphite without any bad effect; but, as we have said before, if the solution were too weak, an injurious effect might be apprehended. The following is the method which we have decided upon as best:—

We put into a bottle, which will contain a quart of distilled water, a glass funnel lined with filtering paper; herein we put 100 grammes of crystalized hyposulphite, and we pour upon it a certain quantity of water, from another bottle, which we renew each time that the funnel is empty. When the bottle is filled it seldom happens that there remains any crys-

* The *Hyposulphite of Soda* is a beautiful salt, as clear as crystal, which has the property of dissolving the iodide of silver produced by the action of the iodine on the daguerrian plate. It is prepared by the manufacturers of chemicals.

talization, and the solution which it contains is in the proper degree of saturation, and ready filtered.

We must first explain the method of subjecting the larger plates to the hyposulphite wash. If it is intended to fix them by the chloride of gold immediately after, no better process can be followed than that pointed out by Mr. Fizeau. (See Chapter X.)

If it is only required to deprive the plate of its sensitive coating, it must be plunged in a flat vessel containing filtered water, and must be withdrawn from thence by taking hold of it by its edges and carrying it horizontally to plunge it into the second basin, which must contain the depth of one centimètre of the solution of hyposulphite, prepared according to our previous direction; immediately after the immersion, the solution must be shaken, and the coating of iodine should entirely disappear in a few seconds. It is again immersed in the first receptacle, which is shaken in order to wash off the small crystals of hyposulphite; then withdrawn, and still holding it with both hands by the edges, it must be placed on the drying-frame (fig. 9), and boiling distilled water poured upon it, or in lieu of that, if there is no hurry, simply cold distilled water; it is now left to dry of itself, by placing it almost upright on one of its angles, in a place where it will be perfectly free from dust.

The washing of plates of small dimensions is much more simple. It is done thus: pour into a flat-bottomed plate half a tumbler of the hyposulphite solution; bring the liquid to one side, by tilting the

plate with one hand,—at this moment, with the other hand, put in the proof; then depress the plate to its level, so that the liquid, in returning, may cover rapidly and entirely the surface of the impressioned plate. Agitate the hyposulphite solution, by moving the plate gently during a few seconds, and when the coating of iodide of silver is washed off, take the plate out by one of its lower angles, and pour upon it filtered water; then, by placing it over the spirit-lamp, you dry one of the upper corners; after this, take the corner so dried between your finger and thumb, and pour again water upon it, taking care that the water does not wet the fingers, and hold the lamp under different parts of the plate successively in circular movements, and at the same time accelerate the evaporation by blowing on the plate, which is thus expeditiously dried.*

If it is intended to fix the proof immediately, it will be sufficient, on withdrawing it from the hyposulphite solution, to sluice it abundantly with water, and place it on the fixing-stand, fig. 10.

* To avoid burning the fingers, the plate may be held with a small pair of flat pliers; or else, if for a large plate, they may place it on a frame introduced by Mr. de Brebisson.

CHAPTER X.

FIXING BY THE CHLORIDE OF GOLD.

Of all the discoveries and improvements which have been made since Mr. Daguerre's invention, the most important is the application of the chloride of gold, for which we are indebted to Mr. Fizeau. But to return to our small plate. We have explained in the preceding chapter, that after taking the plate out of the hyposulphite solution, it was to be plentifully washed in filtered water; it is then placed, whilst still wet, on the fixing-stand, previously adjusted to a perfect level, and then, as much of the solution of the chloride of gold as the plate can contain, is poured upon it. The spirit-lamp is then held under *all the parts of the plate* successively; the image begins first to assume a dark appearance, and then one or two minutes after, it acquires a great degree of intensity; this last effect is always accompanied by the appearance of little bubbles; you then take away the lamp,* wash the plate copiously with water, and

* It is advisable to make use of a lamp of a sufficiently strong flame to produce the effect in a few minutes. If after a first heating you find that the impression can admit of a greater degree of intensity, it might be heated anew; but that is seldom necessary, and often by trying to do too well, the operator, if he persists in heating certain parts of the plate, may find the liquid dry up just above the flame, and inevitably cause a stain, or else the

dry it in the manner we pointed out in the last chapter. If you operate upon the larger plates, it will be best to follow to the letter the description of the process, as given by Mr. Fizeau, which we here transcribe.

"Since the publication of the photogenic processes, every one, and Mr. Daguerre among the first, acknowledged that something yet remained to be done, to give to these marvellous images that degree of perfection, which it is now possible to obtain: I mean the fixing of the impressions, and the giving to the light parts of the image more intensity.

"The process which I now submit to the Academy, appears to me to resolve, in a great measure, this double problem; it consists in subjecting the plate to the action of a salt of gold, prepared in the following manner:—

"Dissolve 1 gramme of chloride of gold in one pint of pure water, and 3 grammes of hyposulphite of soda in another pint of water,* then pour the solution of gold into that of soda, by little and little, and shaking it all the while: the mixture, which is at first of a slightly yellow colour, soon becomes per-

blacks are covered with a film, or even the coating of silver may suddenly exfoliate, when small particles are detached from it: the impression is then entirely spoilt; but the plate may be repolished.

* The above proportions are calculated for these substances in a very pure state; Mr. Fizeau has given the following ones, which will be found generally exact for the quality of these substances as usually sold: one part of chloride of gold to eight hundred parts of water, and four parts of hyposulphite of soda to two hundred parts of water.

fectly limpid. It would then appear to contain a double hyposulphite of soda and of gold, with the addition of marine salt, which appears to perform no active part in the operation.

"In order that this salt of gold process may produce its effect upon the silver coating of the plate, it is important that the latter should be perfectly free from foreign matter, and especially from all greasy particles; it is therefore necessary that it should have been previously washed with great care, which may be dispensed with when you only wish to have recourse to the ordinary wash.

"The following method is the one most generally attended with success:—Whilst the plate is yet covered with the coating of iodine, but exempt from all dust and grease, both on the two surfaces and at the edges, pour a few drops of alcohol upon the iodized surface.

"When the alcohol has wetted the whole surface, immerse the plate first in the filtered water, and afterwards in the hyposulphite solution. This last must be renewed for each plate, and should contain about one part of salt of gold to fifteen of water; the remaining part of this washing process is performed in the ordinary way, only care should be taken that the water used should be as much as possible free from dust.

"The alcohol is used simply to cause the water to adhere perfectly to the whole of the surface of the plate, and to hinder it from running off to the sides

on each immersion, which would infallibly cause spots.

"When a plate has been washed with these precautions, even if the image were very old, the application of the salt of gold would be the most simple possible: you have only to place the plate upon the wire-frame, which is to be found in each apparatus, to pour upon it a coating of the salt of gold, sufficient to cover it entirely, and to heat it underneath with a strong flame; the impression will be found to become distinct, and to assume, in a minute or two, a fine vigorous tone and colour. When the effect is produced, the liquid must be poured off, and the plate washed and dried.

"In the operation which we have just described, the following phenomena have taken place:—silver has been dissolved, and gold has been precipitated upon the silver, and also upon the mercury; but with very different results. The silver, which by its polish, forms the dark parts of the picture, is in some degree browned by the thin coating of gold which covers it, whence results an increased intensity in the black parts; the mercury, on the contrary, which, under the form of infinitely small globules, forms the whites, increases in strength and brilliancy, by its amalgamation with the gold, whence result a greater degree of fixity, and a remarkable augmentation in the light parts of the image."

RECAPITULATION OF THE FIRST PART.

The operator will take care to buy none but plates of a good quality; that is, such as contain at least a proportion of one-thirtieth part of silver. They must be polished with the greatest care in the manner we have stated; and it must be borne in mind that it is better to polish the plate over again, than to operate with one improperly prepared: before placing the plate over the iodine, care must be taken to clear it of any dust which might adhere to its surface, and the remaining part of the operation must be performed with particular attention, often examining the colour of the plate and altering its position, in order to obtain the uniform tint required and to watch the instant when it assumes a golden yellow hue. If it shows greenish and darkened tints, it must be immediately set aside to be polished anew; for those appearances would prove that the plate had been spoilt by the mercury, or else that some traces of a former impression had not been erased, or that some remains of a former fixing process were still on it.

If a few seconds were to elapse before placing the iodized plate over the pan containing the bromine water, and the plate had contracted some particles of

dust, it would be necessary, to whisk them very slightly off its surface with extreme precaution, by means of a tuft of cotton-wool drawn from the bundle; for each of these particles of dust, being saturated with iodine, continues to act upon the plate, all around it, to an extent in proportion to its size, and consequently annuls throughout that space the action of the accelerating substance.

If bromine water is used, it will be necessary to conform to the previous directions; for if the operator were to confine himself merely to diluting it with water, and depending on the colour for the result; or, if he should make the same solution serve several times, or, again, if he were to pour into the bromine pan an uncertain quantity of bromine water—in either of these cases, he would be far from obtaining identical results, and would do much better to be guided by the colour of the sensitive coating, by bringing it to the rose tint, either with the bromide of iodine, the Hungarian mixture, or the bromine-water.

Great care must be taken that, in conveying the plate from over the accelerating mixture to the camera, no ray of light should reach it.

We cannot establish any rule for the duration of the exposition in the camera; but if the operator examines carefully the effect of the circumstances which modify this operation, a very few experiments will suffice to enable him to acquire the necessary dexterity. Adjust the focus with great care; and if you make use of the adjusting lines, pay particular

attention to bring the sliding frame to the mark which corresponds with the distance of the object. It must not be omitted, when the object to be produced is very unequally acted on by the light, to screen either with the cloth curtain, or with a piece of black stuff, its most luminous part. In withdrawing the plate from the camera, the same precautions must be adopted, to preserve it from dust and the action of light, as were taken in putting it in.

The exposition to the mercury should last at least twenty minutes, and sometimes more; however, in any case the plate must be withdrawn as soon as it is perceived that the dark parts begin to assume an ashy hue; in general we advise heating the mercury a little at a time, but frequently. At first it will be good to consult the thermometer; but when once the operator has learnt to appreciate the proper degree of heat, by applying his fingers to the bottom of the cup containing the mercury, it will be better for him to dispense with it. He will take care lest any light should fall on the image, before it has been sufficiently acted upon by the mercury; for that purpose he will not raise the black curtain, which covers the white glass aperture, until after the lapse of several minutes, and when he supposes that the image is already formed.

The washing and fixing by the chloride of gold process will be accomplished by omitting nothing that we have pointed out in the ninth and tenth chapters. The last wash, that which follows the fix-

ing of the impression, may be performed simply with filtered water; but for the large plates it is advisable to follow exactly Mr. Fizeau's process.

The framing of the plate has also a certain degree of importance, by its effect on the picture; in general, white skeleton frames have been in use: we think, that though they are tasteful enough when well executed, they are particularly injurious to the *effect* of the photographic image; for the scale of tints of all these images is extremely circumscribed; it varies from black to a white hue, partaking more or less of a greyish tint. Must not the contrast with the dazzling whiteness of the border of the frame be most injurious to that effect? Frames covered with a darkish-coloured velvet, those which are gilt, and the skeleton frames, with a rather dark border, will do infinitely better.

END OF THE FIRST PART.

SECOND PART.

CHAPTER XI.

OF THE PORTRAIT.

When Mr. Daguerre's admirable discovery was made known to the public, the higher classes of society in all countries hailed it with delight; but artists were divided in opinion concerning it. Some saw nothing in the first attempts that were made in the application of the art, but a cold and stiff copy of nature; and, as far as art was concerned, entirely devoid of interest. Others admired, in the first place, the perfection in the representation of the more prominent objects in the picture, joined to an almost miraculous precision in the details; then, that admirable gradation of shade, which makes each photographic image a masterpiece, we will not say of art, but of nature. But, one important idea then took possession of the minds of those who directed their attention to the art—Would it ever be possible to obtain portraits by the daguerreotype? The answer to that question was evidently dependent on the solution of this other one: Would it ever be possible to operate quickly enough to obtain, in the shade,

during a very short interval, the physiognomy of the person whose likeness was to be taken? We candidly admit that the portraits which were made then, and for a very long time after, gave but little hopes of success even to the most impassioned admirers of the art. The method then followed required that a person should sit for twenty-five minutes, exposed in a glaring sunshine, with his eyes wide open. Some few adepts had the fortitude to endure this; but it will be easily understood that it was all to no purpose. Instead of portraits, the image produced had a corpse-like appearance.

Three years ago we constructed a daguerreotype adapted for portraits.* By having new curves, and by a considerable shortening of the focus, this apparatus operated in the shade in two minutes. This was, it will be admitted, an immense progress; but from thence to an instantaneous reproduction of the image there was an incalculable distance. Soon after, the application of the chloride of iodine by Mr. Claudet gave a new impulse to photography. In accordance with the inventor's wish, we hastened to make his process public, through the medium of the

* "As soon as the defective construction of the first apparatus for the reproduction of portraits had been once discovered, a remedy was found in the adoption of object-glasses of a very shortened focus. Messrs. Lerebours and Buron appear to have been the first to think of this innovation. By this improvement, the concentration of the luminous rays in the camera was increased in intensity, and the duration of the exposition to the sun's rays was reduced to three or four minutes."—*A Treatise on the Daguerreotype, by an Amateur.*

Academy of Sciences; from that time, the hope of reproducing the human countenance could be reasonably entertained. By this process some very fine impressions were then produced, and some magnificent portraits were taken, which were perfect likenesses, and in which only one thing was wanting—expression! Notwithstanding, numerous establishments for taking likenesses were formed; in all large towns the daguerreotype was used for producing portraits; and, what will doubtless surprise many persons, the only two establishments of this kind in London several times realised as much as 60*l.* in one day.

However, the future prospects of the daguerreotype, as applied to the portrait, had like to have been brought to an end by the cadaverous-looking specimens, which were everywhere exhibited. The very idea of a portrait by the daguerreotype, excited a repulsive feeling. And even now, we every day find persons who are quite astonished when they see our specimens, so great is the contrast between them. The reason is obvious: for a fine impression, produced rapidly with a good object-glass, unites, together with the truest expression, the most exact likeness, and the most exquisite finish of the details which are produced, without detriment to the effect of the masses, or to the correctness of the lines; that is to say, all the perfections of which the art is susceptible.*

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* "Notwithstanding these admirable results, which would have been hardly credible if they had been obtained at the onset, and if they had not

ON THE CHOICE OF THE APPARATUS.

Many persons being at a loss what apparatus to choose, when they wish to purchase one, a few words of advice on the subject may be useful.

If the apparatus intended to be purchased is destined almost exclusively for taking portraits, the one-

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been the fruits of successive discoveries, and of the most persevering studies and labours, the photographic portraits, which have so many admirers, have also their enemies.

"Some, who are unacquainted with painting and drawing, and ignorant of the theory of shading, that of the chiaro-scuro, and of the laws of perspective; will never admit that anything of a good effect can be obtained without the use of colours. They reckon as nothing, that admirable gradation of light and shade—that perfection in the relief—that purity of outline, which constitute the principal charm in photographic images. In a word, the most exact reproduction of nature is of no value in their eyes, if it appears divested of its colours. This class of adversaries is unfortunately more numerous than is thought; but it is not our province to teach them the elements of art or taste.

"Others refuse to admit in the daguerrian pictures, anything more than a mere copy of nature, which though faithful is cold, unmeaning, and devoid of that divine animation, in which all the talent of the artist and the merit of works of art consist. The portraits which are executed every day, in which the harmony of the attitude unites with the expression of the face, are there, to refute triumphantly if not to convince them. It is true that a great number of photographic portraits are daily exposed to view which would almost make one despair of the art; but have the masterpieces of a Rubens or a Raphael ceased to be admired, because so many trashy productions have since their time been produced?

"But the most dangerous enemy which the daguerreotype has had to contend with, is incontestibly human vanity. When a portrait is executed by the ordinary method, the flattering pencil of the artist can soften any harshness in the features, give suppleness to any stiffness in the attitude, and to the whole figure grace and dignity. It is chiefly in this that the talent of the portrait-painter consists; we require, it is true, that the pic-

sixth size, with one single achromatic lens, should be preferred, especially if the purchaser intends to make it a source of profit, by the practice of the art. It is, as we have already said, the apparatus which, of all others, operates most rapidly. If that size were thought too small, the apparatus with a double object glass for the quarter sized plate should be chosen. These two sizes are the most generally used.*

Those who will not be deterred by a rather considerable expense, and who have sufficient perseverance, not to be discouraged by the greater difficulties which attend the use of the half-sized or normal plates, will be amply rewarded for their pains by the splendid full-sized portraits, and magnificent groups, which may be obtained upon plates of these large dimensions.

ture should be a resemblance; but above all, we desire a handsome one: two conditions which are often incompatible.

"Not so with the photographic artist; unskilful in the art of flattering or correcting the imperfections of nature, his portraits have unfortunately the defect of being often too true; they are in a manner permanent mirrors, in which our self-love does not always permit us to look with pleasure."—*A Treatise on the Daguerreotype, by an Amateur.*

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* DIMENSIONS OF THE PLATES FOR THE DIFFERENT SIZES OF APPARATUS

	m.		m.	Inches Fr. measure
The normal or full sized apparatus, with plates of the size of . .	0.16	by	0.22	(6 by 8)
Ditto . ½ size plate .	0.12	„	0.16	(4½ „ 6)
Ditto . ¼ ditto . .	0.08	„	0.11	(3 „ 4)
Ditto . ⅙ ditto . .	0.07	„	0.08	(2½ „ 3)

ON THE LOCALITY.

The rapidity with which it is now possible to operate, allows of taking the portrait in any place, and at any time of the day; however, it is advisable for the operator to choose the most favourable conditions in both respects.

In order to obtain impressions with the rapidity we have spoken of in the foregoing chapters, it is desirable to choose for the situation in which to operate, an open terrace; but, at the same time, to avoid being exposed to the direct rays of the sun, against which a screen, or a piece of gauze, may be raised. In any case, the object to be reproduced should always receive a little more light on one side than on the other, and should be placed underneath a kind of canopy, either in cloth, canvas, or a more solid material, so that too much light may not fall upon the top of the head and the forehead. With the precautions above-mentioned, the model receiving from all sides a diffused light, will be exempt from the harshness inseparable from portraits taken in the sun.

To produce a portrait in a room, the operator should place himself within a few feet of a high window, the apparatus being placed close against it: in places where the walls are dark, one or more sheets of white linen, or cotton cloths, are hung up so as to reflect the light upon the model. The portraits thus

obtained, may receive the light either in front, or from the side, according to the taste of the artist; they have in general a more defined outline than those taken in the open air.*

It is impossible to determine positively the precise duration of the exposition in the camera; those who wish to form a correct idea on the subject, may consult the 7th chapter. It will be understood that the operator will be guided by what has been previously said; but he must observe, that in the interior of a building, the light being admitted by a single window, at a greater or lesser distance, this opening is very small, compared with the extent of a semi-horizon, and at an angle of at least eighty degrees, which is the extent of open sky in the portraits made on a terrace, or in a garden.†

The portraits obtained in the sunshine have strong contrasts of light and shade, and a great degree of vigour in the outline; it is possible, with that strong

* The *rest* for the head, excepting when operating instantaneously in the sunshine, is indispensable, if you wish to obtain a perfectly defined portrait.

† To give an idea of the difference of time necessary for taking a portrait inside a room, and outside, in the full light of day, we may mention what took place at the Palace of the Tuileries, when Mr. Claudet and I were admitted to take portraits of the King, and a part of the Royal Family. The sky was at the time veiled with very luminous white clouds. At about the distance of six feet from the immensely large windows, which are towards the garden (that is to say, towards the south), it took us eighty-five seconds with the one-fourth apparatus, with a double-object glass. All the circumstances remaining the same, but in the open air, on the Terrace of Philibert Delorme, fifteen seconds were sufficient; and thus we were enabled to obtain, by this exposition, several good portraits in less than a quarter of an hour.

light, to obtain delightful groups full of life and animation. They will be, as will be easily conceived, invaluable to the artist in more than one respect; but in general, they will seldom be agreeable as portraits, for very few persons can endure so strong a light without distortion of feature,* neither do we mention them but as exceptions.

It is particularly recommended to amateurs, and still more particularly to those who devote themselves to the daguerreotype as a profession, whatever be the light employed, to make it fall upon the model in a proper manner, and, not only to give it a pleasing and natural position, but to choose that which is the most favourable.† The taste of the artist is, in this case, of the highest importance; for, the two greatest difficulties in making good portraits consist, in our opinion (the apparatus and elements being of the first quality), in the good preparation of the plates and in the proper position of the model.

As a general rule, if you take a bust the apparatus

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* There are many persons who cannot sit for a portrait in the open air, even when the sky is clouded; thence our canopy of blue glass has been of great use to us for persons with weak sight, and to operate in windy or rainy weather. However, the blue glass is not indispensable, and the same effects may be produced by light hangings of that colour.

† For the apparatus of the one-sixth size, and for all those with a very short focus, care must be taken that all the parts of the figure should be as near as possible equidistant from the object-glass. The legs should be turned sideways, in order to avoid giving undue proportions to the feet and knees. For the same reason, the hands should not be advanced too far from the body, or they would appear enormously large. However, these defects are only apparent, even with an apparatus constructed with a short focus, when you operate too near.

should be placed at about the height of the eyes; the effect of which will be, that the upper part of the head, the seat of intelligence, will acquire a slight development. (Some persons' likenesses require to be taken full face, the greatest number only three-quarter face; whilst others, which look extremely well, and produce a very fine profile, would have no charm in the other two positions.)

To avoid the unpleasant effect produced when the eyes are represented as immovably fixed, which occurs whenever the person whose portrait is to be taken rests his eyes upon a near point during the operation, it is advisable that the sitter should look *vaguely* at a distant object; if, during the time that the sitting lasts, the mind were actively occupied with a serious or pleasing thought, according to the expression that may be desired, but without being at all preoccupied with the object towards which the eyes will be turned, the portrait will be full of animation and intelligence.

OF THE DRESS AND BACKGROUNDS.

During the first period of the discovery of the daguerreotype, one of the strongest arguments dwelt upon by its enemies was the small number of cases in which it was applicable.

Thus, in order to take a general view of a town or edifice, it was necessary that these objects should receive the light in a nearly uniform manner, without

which the dark parts would not *come out* when the light parts, illumined by the rays of the sun, were *passed.* It was by the same cause that they never could obtain a complete portrait of a person who had on a white waistcoat and a black coat. Fortunately, as new accelerating substances were successively discovered, they were found endued with the singular property of lessening proportionably the difference of action which exists between two bodies differently illumined and of different colours. It is thus that at present, in the views that we take in the sunshine in a fraction of a second, with the apparatus of the 1-6th size, the clouds, buildings and trees are reproduced all at once, and each according to its value.

From what precedes, it will be understood that the choice of a background and the colour of the dress of the party sitting, have less importance than formerly.* However, as a general rule, it is advisable to adopt dark-coloured clothes; silk and satin gowns give very fine reflections of light, and the Scotch plaids especially will be reproduced with such variegated tints as to represent in some sort their colours.† The only inconvenience attending the use

* We saw, a few days ago, in the hands of Mr. Eynard, the finest group that ever was produced on a large plate. The background had been taken from nature, and contained some young trees, amongst which, several firs. One of the figures was dressed entirely in black, and one lady had a white bonnet; notwithstanding which, nothing was burnt or solarised, but *every part of the picture had come out perfectly.*

† When the clothes are dark, you must make use of the black cloth curtain, *a b c d*, fig. 6, which is let down before the object-glass, in such a manner as not to allow the rays of light reflected from the face and linen

of light-coloured or white clothes is to make the face appear darker, by contrast, than it is in reality.) Notwithstanding, the operator would do wrong to banish them entirely from use: for example, blond, gauze, or net collars, for ladies, will produce very pretty effects.

The background adopted should be one which will reflect light upon the clothes, but which, however, should come out less than the face, otherwise the latter would appear dark. The backgrounds which we recommend according to the complexion are the following: a yellowish white, a light grey, and a very dark grey;* though we do not mean to say other colours may not be equally good: for example, an old woollen blanket will produce an excellent background, whether it be spread out, and some pictures hung on it for ornament, or disposed in drapery as a curtain, or allowed to fall naturally. For a full-length portrait, it would be well to add a few pieces of furniture of an elegant shape, such as a lady's work-table, a book-case, or some such ornamental pieces of furniture, and to dispose tastefully upon them a few books, glass ornaments, a vase containing flowers, objects of art, &c.

Thus much for plain backgrounds; but, as often as it is possible to obtain one representing either a land-

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to pass through it, but only those from the dark parts of the dress. Experience will teach what should be the prolongation of the exposition for this part of the picture.

* The latter for very fair and light-haired persons; for elderly persons, and ladies with a white cap or bonnet.

scape or the interior of an apartment, it should be adopted in preference ; for, if it be properly selected, that is to say, one of a dull colour, and consequently allowing the portrait, which is placed in the foreground, to receive the more vigorous effects of the intense light, the effect will be extremely harmonious ; the portrait will be thrown out in admirable relief, and, to use a common expression, it will seem to stand out.

Mr. Claudet is the first who had the happy idea of thus placing painted backgrounds behind the persons whose portraits were to be taken. According to this idea, the operator might be provided with different subjects, such as a landscape, the interior of a drawing-room, a study, or library, &c.

ON THE COLOURING OF PORTRAITS.

THE question whether it will ever be possible to reproduce colours by the daguerreotype, is one which has much and deeply occupied the attention not only of photographists, but of the public in general. It would be rash to raise any expectations of the solution of this problem, which, if ever solved at all, will probably be so by some happy result of chance.*

* It has been a subject of anxious inquiry whether, after having obtained by the daguerreotype the most admirable gradations of light and shade, it will not be possible to obtain by it the reproduction of colours; to substitute, in a word, *paintings* in lieu of the sort of *aqua-tinta* engravings which are now produced.

This problem will be solved only when an elementary substance shall be

The public papers have often announced that Mr. So-and-so, of such a town, had discovered the means of reproducing colours by the daguerreotype. Many operators, some of whom were perfectly sincere, have imagined that they had made this discovery, because they had obtained two or three different tints on one or more plates. That, however, was simply the result, as every one may have remarked, of the more luminous objects having assumed in the picture a blue cast, while the other parts, which had reached their proper colour, remained of a white or bistre tint. Many persons have latterly announced being able to reproduce portraits with colours. It would have been more

discovered, which the red rays will colour red; the yellow rays, yellow, the blue rays, blue, &c. Mr. Niepce had already discovered effects of this nature, in which, in my opinion, the phenomenon of the coloured rings performed a certain part. Perhaps it was the same, in respect to the red and violet, which Sybeck obtained simultaneously on the chloride of silver, at the two ends of the solar spectrum. Mr. Quetelet has just communicated to me a letter, in which Sir John Herschell announces that his sensitive paper, having been exposed to a very vivid solar spectrum, afterwards showed all the prismatic colours, excepting the red. In presence of these facts, it would certainly be rash to affirm that the natural colours of objects will not one day be reproduced in photogenic images.

Mr. Daguerre, in the course of his first experiments on phosphorescence, discovered a powder which emitted a red glimmer after the red light had acted upon it; another powder, to which the blue rays imparted a blue phosphorescence; a third powder, which assumed a luminous green colour by the action of the green light: he mixed these powders mechanically together, and thus obtained a compound which became red under the influence of red rays, green with the green rays, and blue in the blue rays. Perhaps by operating in like manner, and mixing together various resinous substances, some one will succeed in obtaining a kind of varnish, in which each species of light will imprint its colour no longer phosphorescently, but photogenically.—*Notes of Mr. Arago.*

correct to say that the portraits were first obtained and coloured afterwards. Several patents have been taken out in relation to this matter, and we shall abstain from giving an opinion as to what may be contested in respect to the rights they confer; we shall content ourselves with simply alluding to the fact. The first, obtained by Mr. Laicky, is drawn up in such mysterious language that we frankly acknowledge our inability to understand it. It appears, however, to result from the use of water-colours applied by some seemingly dexterous process. The invention of Mr. Léotard, of Leuze, consists in pouring upon the plate a solution of gum or starch, heated by contact with hot water in a separate vessel, and laying on the surface of the plate a transparent membrane or a vegetable paper; and then colours, mixed up with spirits of wine and gum, or else with white varnish and alum, are applied upon this membrane.

Mr. C. Chevalier has given a method, which we will now proceed to explain. Before fixing the glass destined to protect the portrait, it must be placed on the plate exactly in the position which it is meant to be in, and slightly trace on its exterior face the outline of the entire bust, and the lines of the different parts of the portrait; and then, with transparent colours,* lay on the dull tints, corresponding as much as possible with those of the parts which they are intended to represent. When the painting is quite dry, the

* The operator must make use of the colours with which the glasses for the phantasmagoria are painted.

glass is fixed and the tracing effaced. The tints and half tints of the proof, visible through the transparent colours, will impart to the latter the shades they are wanting in, and an effect will be obtained which will resemble very nearly that produced by coloured lithographic prints.

The following is the unpatented process which has been communicated to us by Mr. Claudet:—Take some colours (those used in water-colour painting,) in impalpable powders; these colours are pounded over again with spirits of wine, and when dry they are again pulverised with a glass pestle.

To give the first tone to the portrait, you dip a very finely-pointed hair pencil into spirits of wine; take a little colour of the proper tint, but very little of it, and apply it upon the plate.

This first coating must be a very slight one; and it would be much better to go over it two or three times than to lay on at once a quantity of colour which would cause a stain, and which you would have a great deal of trouble to take off. This first operation is intended to make the pulverised colour bite, and it is afterwards applied with a dry brush.

This process, simple as it is, requires some notions of painting; for, even when used by *artists*, it gives results which are *always inferior* to a very fine photographic impression; still more so, if a person unacquainted with the art of painting, merely applies a little red on the cheeks, lips, &c., the effect is, in our opinion, decidedly bad.

We should not have dwelt so long upon this subject, but for the interest which many persons take in it. For our own part, we are not at all admirers of the process, as we think that to daub over, by the hand of man, a photographic image, which is one executed by Nature herself, is much like having one of Madame Mirbel's exquisite miniatures retouched by a sign-painter.

CHAPTER XII.

OF INTERIORS.

It is agreed to designate, under the appellation of interiors, those impressions representing groups of objects of art, such as furniture, statues, or busts in marble or plaster, &c., bronzes, crystal articles, silk or woollen stuffs, armoury, objects of natural history, &c., &c. To obtain a satisfactory result, the first point necessary is to know how to group them with taste, which cannot be taught; but there are some conditions of success which may be pointed out: as we have practised but little these reproductions, we shall have recourse to the notes of Mr. Hubert.

"To obtain a good reproduction of the objects in question, it is best to choose the time when the sky is partially clouded; and if, during a part of the operation, you are so fortunate as to have an occasional glimpse of sunshine, the impression will be very harmonious; the shades produced, instead of being of a

dull black tone, will be perfectly transparent, for the details will have had time to be formed in them by the diffused light, and the sun's rays will give the most brilliant touches.

"Few persons having in their possession collections of iron armour, bronze vases, stone or marble capitals of columns, wood carvings, sculptures, &c., they may, with simple stained plaster models, obtain, with little cost, all the treasures of our museums. It is thus that I have, for my own part, converted into valuable matter some old models, by only daubing them over with coloured wash; for it is not at all necessary to colour the object that you wish to copy to the exact tone that it would have in nature; it will be sufficient to give it a colour having a relative approximation to that you wish to represent. You may, for example, use indifferently green or red to obtain in the impression the same value of tone.

"Plain or cut-glass objects, glass or crystal vases half-filled with water or coloured liquids, still-water employed as a reflector, objects of art in bronze, gold, or silver—those of a black or very dark red colour, but varnished or polished like Etruscan vases, are highly favourable in this case, by the contrasts which they produce, and by the play of the reflection of light resulting from the polished or varnished surfaces, the reflection of the surface of the water and liquids, and the glistening of the glass and crystals.

"Subjects composed entirely of plaster figures or of white drapery, are more easy to execute, but they

become monotonous, are often undefined in outline and devoid of effect; it is therefore better, in certain cases, to introduce objects more or less coloured, and thus obtain by contrast, and by narrowing the field of light, blacks and whites of greater intensity.

"These compositions should be arranged in a place open at the sides, at which the light is to be admitted, and placed, if possible, on a turning-easel, in order to choose the most proper disposition of the light. On exposing these objects entirely in the open air, it often happens that the light of the sun, combined with that of a very luminous blue sky, destroys a part of the modelling. It is therefore preferable, for portable objects, that you wish to copy with fine modellings and sharp effects, only to admit the light by one side.

"As naturally diffused light, with an echo of more vivid light, is not always to be obtained during the intervals of sunshine, as you wish, it has often happened to me, with a partially, clouded sky, when the sun, at intervals, appeared more than I wished it, to hinder momentarily the action of the light by covering the object-glass, with its diaphragm made very moveable, or for more precaution with my handkerchief, until the next cloud arrived.

"Very pretty effects are also obtained when the sun, throughout the operation, being slightly veiled, either by a mist or clouds which intervene, has yet sufficient force to produce shadows. In such cases, the light not being too vivid, the operation may last

longer, and the details in the shade have time to come out.

"Chance has also sometimes furnished the means of producing some very striking effects of light, which I should never have thought of. I allude to a vague and slight shadow which concentrated the light on a certain point of the picture, though the whole was illumined by a bright sunshine; it was occasioned by the extremity of a very slight branch of a tree divested of its leaves, and interposed between the sun and the object upon which its beams fell. It was impossible to perceive in the impression the slightest trace of the form of a shadow, nor even any difference of light resulting from the interposition of this slight object (which was at a distance of fifty yards), and yet this effect was very plainly discernible on the plate, which was subjected to the same operation four days running, at the same hour, and under all the same circumstances.

"In order to operate successfully when the sky is clouded, with an occasional echo of light, it is necessary, when the sun shines out powerfully, to use a very fine gauze, the threads of which must be, however, sufficiently apart to allow a little of the direct light of the sun to penetrate between them; and when the operation is nearly finished, for those parts that are in the shade, take away the gauze, and allow the sun's light to give the finishing touch to the lights of the picture."

CHAPTER XIII.

ON FIGURES FROM THE LIFE.

What we have just said of the reproduction of objects of art, may be equally well applied to that of figures from the life. For these latter, in the absence of a competent study of art, the operator should possess a very positive artistical taste, as the choice of the attitudes presents numerous difficulties.

More than for any other reproduction, you must not place the apparatus too near the model, and should avoid the different parts of the body being at too-widely different distances from the object-glass.

The operator must not be too prodigal of accessories, as a great degree of simplicity often adds to the merit of such pictures. He should therefore prefer handsome hangings, of a dull tone of colour with large folds, to a background of too brilliant a pattern.

The first figures from the life that we took, two years ago, were so far successful, that the greater number are now in the hands of the most eminent artists. We intend soon to produce others.

For all these reproductions, and for groups composed of several persons which require to be represented with precision, the operator must not

confine himself to fix the focus according to the adjusting lines; but he must examine repeatedly the image on the ground-glass; by which means he will be able to secure a good general effect, and will often discover and remedy a number of unfavourable details, which might have escaped his attention had he only looked at the group itself.

CHAPTER XIV.

ON VIEWS.

We comprise under this denomination those pictures representing either an edifice, a general view, or a landscape. For the preliminary operations you must conform to what has been said at the beginning of Chapter VII. For a view with an extended horizon, or for the reproduction of a landscape, you must take great care not to adjust the point of view by the distant parts; but, on the contrary, reserve all the clearness in focussing for the first and second range of foreground. The choice of the position given to the apparatus is of very great importance to the result. In taking an edifice, withdraw, where the nature of the ground will allow it, to a distance of double its greatest dimension; you will thereby avoid making it appear on the plate as if cramped for want of room. It is also requisite to choose a position at an elevation of about one-third

of the total height of the edifice; otherwise, in order to take the whole of it, it would become necessary to incline the camera, and then the vertical lines, which ought to be perpendicular and parallel to each other, would, as Mr. Hubert observes, meet at an accidental point of incidence of the sky, and cause the edifice to appear as if falling.*

Avoid as much as possible reproducing on the same plate an old edifice darkened by time, and a new or light-coloured one. The time necessary for taking the first exceeds, by a great deal, that required for the latter; hence, it follows that the new building would be more or less overdone before the other

* "There are certain views which it is very difficult and almost impossible to represent; they are those in which the operator is obliged to place himself near an object composed of conspicuous and distinctly marked lines of view. In such a case, if you have a building or interesting site to take, and wish to have all the details with exactness, the best method to adopt is, without changing the position of the camera, to take several proofs, changing the focus for the different lines of view that you wish to obtain.

"But if you had only time to take a single impression, then you must select the most interesting point of the view for adjusting the focus, even though the other parts should be introduced with a certain degree of vagueness.

"I can corroborate the propriety of this advice by adding that, in following this method, the operator would be imitating that of very eminent artists, who have adopted it after numerous observations and a close study of nature, and who, in order to attract the attention of the spectator to the most interesting part of the picture, devote all their talent to its embellishment, and purposely neglect what is only accessory."†—*Notes of Mr. Hubert.*

† The reader will see that the opinion of Mr. Hubert agrees with that which we have ourselves expressed, at page 35, relative to the effect that one should endeavour to produce in a picture.

would have time to come out: however, when the case does occur, you may surmount this difficulty by making use of the black cloth which we have before recommended to be placed in front of all cameras. This is evident, for, if the part of the picture which has most light is on the right, it will be easy, with the cloth, to prevent the rays which come from that part reaching the object-glass. Recourse may be had to this expedient in numerous circumstances, and it will even be *almost always* indispensable when you wish to hide the sky during a part of the operation, and hinder it from being overdone; for example, you must not fail to use it every time that you wish to obtain a reproduction of fine groups of clouds. If you have not a black cloth, you may make use of a *red* handkerchief; indeed, it has often happened to us, when in the country, to use a thick green leaf of a tree, the form of which sometimes adapts itself *perfectly* to the part that you wish to hide. In order to ascertain exactly the effect produced, and to avoid acting hap-hazard, examine attentively, during the first experiments, the effect produced on the ground-glass.

It is chiefly in the reproduction of landscapes that one is often obliged to hide certain parts of the picture; and the reason is obvious: it frequently happens that you have to make the study of a tree, or else that the picture is formed of two perfectly distinct zones; on one part, the ground covered with vegetation, and the sky on the other. Now, it is

well known that the green colours are the most difficult and tardy in coming out, whilst the sky is reproduced with extreme rapidity. In the first case, we have often used with success an indented leaf which masked the whole of the sky, and which allowed time for the tree to come out with good effect. In the second case, the use of the curtain to mask the sky is extremely easy and convenient; it is only necessary to raise it entirely for the first part of the operation, and afterwards to lower it to the line of the horizon, at which point it should be kept in motion until you entirely shut out the light. In taking views of glaciers, or mountains covered with snow, it is impossible to obtain the least effect unless you employ this curtain.

CHAPTER XV.

OBSERVATIONS ON MR. DAGUERRE'S PROCESS.

Several theories have been successively propounded, to explain the various phases of Mr. Daguerre's photographic processes. Here follows a succinct account of them, such as given by Mr. Dumas, Professor of Chemistry to the Faculty of Sciences, in his instruction to his class:—

1. *Preparation of the Plates.*—All the processes recommended for preparing the plates, such as the rubbing with tripoli, either with acid or spirits of

wine, are intended solely to lay bare the metallic surface; therefore, the nature of the polishing substance used is a matter of indifference: the only essential condition is to leave no residue on the silver; and Mr. Daguerre's late communication (see page x.), has no other object than to enforce the necessity of completely baring the silver by a still more perfect method of cleaning.

2. *Application of the Sensitive Coating.*—The yellow gold tint produced on the plate by the coating of iodine, is caused by a very thin film of iodide of silver. This colour is not that which is peculiar to the iodide, for that compound is white, and it only acts in this case as a thin lamina; so true is this, that, when the action of the iodine is prolonged, the yellow coating is seen to pass successively through other gradations of colour (see page xx.).

Mr. Dumas has ascertained, by the augmentation in the weight of the plate, the probable thickness of the coating of the iodide of silver.

A plate of 5760 square millimètres of surface, weighed first with nicety, having been brought to the tint of straw-coloured yellow by being exposed to the vapour of iodine, was afterwards re-weighed with the same nicety, and the tare exactly ascertained: there was an increase of weight certain and evident, but it did not amount to one half of a milligramme. When the shade became of a yellow gold colour, the increase of weight reached half a milligramme. By prolonging the duration of the action of the vapour

of iodine beyond the necessary time—in quadrupling it, for instance—Mr. Dumas obtained effects which could be easily appreciated in the scale, there being an augmentation of weight of two milligrammes. He supposed that a quarter of the quantity would have sufficed to form, over the whole surface, the quantity of iodide necessary for the production of the image.

But in calculating the weight of the iodide of silver, which this iodine represents, and in calculating the volume of iodide which corresponds with this weight, you may arrive at the appreciation of the thickness of the coating of iodide of silver deposited on the surface of the plate.

This thickness does not equal one millionth part of a millimètre.

3. *Formation of the Image.*—The action of the light upon the iodized plate in the camera is not visible. It is probable that its effect is to raise, or crack the coating of iodide of silver, which allows the mercury to come in contact with the silver surface of the plate, whilst the iodide that has not been affected by the light remains the same.

When seen through the microscope the mercurial coating presents a very irregular and granulated surface; each particle composing which is of $\frac{1}{800}$th of a millimètre in diameter. The white parts are covered with them, the half tints have them in smaller quantities; the dark parts have none at all. In a word, the mercurial particles are deposited in quan-

tities proportioned to the coruscations of the iodide of silver.

It may be asked, in what consists this coating of mercury? In the opinion* of Mr. Dumas, it is mercury in powder merely deposited on the surface of the silver, but not amalgamated with it.

No theory has been as yet proposed as to the formation of images by yellow glass; and we think that the explanation of this phenomenon could hardly be made to agree with the theory of Mr. Dumas. When examined through the microscope with an amplification of three hundred times, the impressions made with the yellow glass present exactly the same aspect as those produced with the mercury; only in the latter, the white globules, particularly those which are formed on the dark parts of the picture, are much more numerous than those on the impressions obtained with the yellow glass.

4thly. *The Hyposulphite Wash.*—This wash is intended to deprive the plate of the iodide of silver. This iodide, if left on, would soon assume a very dark tint, and would give the picture a very disagreeable tone of colour.

5thly. *The Fixing by the Chloride of Gold.*—The object of this operation is to cover the daguerrian plate with an excessively thin gold film, which augments the vigour and lights of the picture, and renders it indelible without in the least affecting its distinctness.

THIRD PART.

CHAPTER XVI.

PREPARATION OF THE POUNCE AND TRIPOLI.

THE pulverised pounce is a substance which can be had at so cheap a rate, and the processes by means of which it is prepared are so simple, that it is useless to point them out; only, the pounce which is sold in general being very coarsely pulverised, we shall here give the means of preparing it as fine as it is required, at very little expense.

Put a small handful of the pounce usually sold into a large decanter-full of water; shake it briskly during a few seconds, and then let it settle. Of course the largest grains are immediately precipitated to the bottom; those of a smaller size will be two or three minutes before settling down; and at the end of four or five minutes there will only remain in suspension an extremely fine powder. You therefore let the mixture remain still during about that time, and then pour off a part of the liquid, taking great care not to shake it, into a large funnel lined with filtering paper. All the pounce that is in suspension will remain in the funnel. Put some more water

and pounce into the decanter, and shake it again, and then proceed as you did the first time.

The pounce, when withdrawn from the filter, should be dried in a crucible or porcelain cup, then put immediately into the little bag or small bottle covered with muslin, and kept in a very dry place.

OF THE TRIPOLI.

The tripoli in pieces should be of clear yellow tint, soft to the touch, but without feeling too unctuous.

To avoid loss of time, the tripoli which contains too many foreign substances should be rejected ; and it is easy to verify that by breaking up some pieces of it. When it has been pulverised with the pestle, put the powder into a crucible, which heat strongly, but not to a red heat. Put this powder into a large decanter, and proceed as with the pounce ; only, to be deprived of all humidity, the tripoli requires to be calcined more than the pounce.

OF THE ROUGE.

The English rouge ought to be of the first quality ; for if it contains greasy matter, or gritty particles, it would be better to dispense with it, and use only the tripoli. It cannot be prepared by an amateur.

CHAPTER XVII.

OF THE ACCELERATING SOLUTIONS.

We have before said, that of all the accelerating substances, the best in our opinion is the bromine-water, *of a determined strength.* The reader will see, by Mr. Fizeau's "Mémoire," how simple and easy is its preparation. We have said at Chapter VI. that the results which are obtained by it are always identical. It seems, therefore, very probable to us that all the other compounds of uncertain action will be at last entirely superseded, as they are already to a great extent by the bromine-water. We have said that the Hungarian liquid possessed much of this uniformity of action: those persons who do not like to change each time the solution, and who prefer applying the accelerating substance, not by counting the number of seconds, but by consulting the tint of the sensitive coating; must employ this liquid in preference to any other. However, as certain substances, such as the chloride of iodine, used by Mr. Claudet, which was the first proposed, the bromide of iodine, and other mixtures, obtained a great degree of success when first introduced, and as several experienced persons still use them, we have thought it would be proper to give the manner of their preparation and use.

In all these liquids iodine and bromine constitute a larger or smaller proportion. The iodine is indispensable, to form, by its combination with the silver, the coating of iodide; and the bromine applied upon this compound increases its sensitiveness; the iodine must alone be in contact with the silver, to form an iodide; what proves this is, that its compounds, such as the Reizer liquid and the iodide of bromine, the use of which dispenses with the iodine-box, because they contain an excess of iodine, possess a much greater degree of sensitiveness; whilst all the substances in which the bromine is in excess can give no result until after the application of the coating of iodine.

We will successively give some details on the preparation and use of the bromine-water, of the chloride of iodine, of the bromide of iodine, and of the Hungarian liquid, all which serve after having made use of the iodine-box. We will afterwards say a few words on the Reizer or German mixture, and how to make use of the iodide of bromine, both which are used without the iodine-box.

PRACTICAL DETAILS ON THE USE OF BROMINE, BY MR. FIZEAU.

"When Mr. Daguerre's iodized plate is exposed to the vapour of the bromine, the latter is absorbed, and a coating is formed, the sensitiveness of which increases with the quantity of bromine absorbed up to a certain limit, beyond which the picture cannot

be rendered visible by the mercury. The favourable point for operating is near this limit; too near, the impression begins to be obscured; too far from it, the sensitiveness diminishes: it was necessary to determine this point with precision, and to obtain it with regularity—which has been attended with some difficulty; for we cannot, in this case, have recourse to the colour of the sensitive coating, which changes but little under the influence of the bromine; the orange-yellow tint of the plate does indeed deepen a little by the formation of the bromide, but the colour of a plate bromined to a proper degree, and that of one which has passed the limit I have spoken of, differs so little that the operator can, by that only, appreciate in a very uncertain manner the quantity of bromine absorbed, and consequently the sensitiveness of the plate.

"The method which I have proposed is exempt from this cause of uncertainty; it consists in exposing the plate to the vapour of an aqueous solution of bromine, of a determined strength, during a determined time. I will try to explain this more at length:—

"1. *Of the Solution of Bromine.*—To prepare a solution of bromine, of an ascertained degree of strength, and adapted to the operations we are treating of, the first thing to be considered is the saturated solution of bromine in water; this saturated water is prepared by putting into a bottle pure water and a large excess of bromine; you shake the mixture well for a

few minutes, and before using it, let all the bromine be taken up.*

"An ascertained quantity of this saturated water is then diluted in a given quantity of pure water, which gives a solution of bromine that is always identical; this dosing is performed very simply in the following manner: take a small glass tube, which may be applied also to other uses, and, having marked on it a line measuring a small quantity, have also a bottle with a similar line, measuring a quantity equal to thirty times that of the tube; then fill the bottle of water up to the mark, and fill the tube also to the mark with the saturated solution of bromine; then pour the smaller measure into the bottle.†

"The nature of the water used is not in this case unimportant; the proportions above mentioned have been established when calculating upon having perfectly pure water; but it is well known that the water of rivers, springs, &c., is not pure; but these different kinds of water may all be used with equal advantage to pure water, by adding a few drops of nitric acid, until they have a very slight acid savour: five or six drops per quart suffice for most kinds of water.

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* Mr. Bisson has proposed the use of a sort of aerometer for the obtaining a solution which should be always of the same strength; it is easy of application, but this instrument requires, in addition to it, tables of corrections for the different degrees of temperature.

† The reader has seen, at Chapter VI., that we advise the use of the bromine-water, at the degree of strength of 1-40th, and that we recommend to substitute our bottles with marked divisions in lieu of the glass tube.

"A bright-yellow liquid is thus obtained, which must be kept perfectly air-tight: it is the normal solution, which I shall simply call bromine-water, to distinguish it from the saturated water.

"2. *Of the Bromine-box.*—The box employed to expose the plate to the vapour of the bromine-water may be constructed in different ways; that which I have employed from the first is arranged in the following manner:—

"It is made of wood, and folds up, in order to occupy less room; it should be blackened inside with a colour which cannot be attacked by the bromine; its height is about six inches; the other dimensions should be such that the plate may be at about an inch and a quarter from the sides every way. It is divided into three distinct parts: the lid, which serves as the plate-board; the body of the box; and, lastly, the bottom, on which is placed the evaporating-pan: this movable bottom is a little hollowed out in the middle, which serves to put the pan exactly in the same place in different experiments.

"The evaporating-pan should be flat-bottomed, shallow, and about half the size of the plate: it should be covered over with a sheet of glass, fitting it exactly, to prevent evaporation.

"The tube I have spoken of will serve to put into the pan a uniform quantity of bromine-water; it must, therefore, be sufficiently large to contain enough of the liquid to cover all the bottom part of the pan.

"3. *Manner of operating.*—I have before said that the plate should be exposed to the vapour of a solution of bromine of a given strength, during a given time. Now, for the bromine-water to be always of the same strength, in successive experiments, it is evident that it must be renewed for each plate: this is the only means of obtaining a constantly similar evaporation; and I have only thought the use of the bromine practicable, since I had the idea of resorting to this very simple method.

"As to the time during which the plate should remain exposed to the vapour of the bromine-water, it will be easily understood that it must vary with the dimensions of the box, the surface of evaporation, &c.; but, with the same apparatus, it is constant with the bromine-water of the strength laid down. We have pointed out above, the time of exposition should be between thirty and sixty seconds, according to the size of the apparatus: a few trials will suffice to determine the duration, once for all, for each box used.

"I shall point out, in a few words, how this is done.

"Place only the bottom of the box, with its pan, upon a table; fill the tube with bromine-water, which pour into the pan at one of the angles of the same, after having pushed aside the ground-glass sufficiently to admit the point of the tube, and replace the glass; then, if the box is not placed horizontally, arrange it so by means of the coloured bromine-water seen through the glass-plate; when the pan is perfectly

level, and the liquid covers uniformly the whole surface, complete the arrangement by placing the second part, or body of the box, over the bottom.

"Everything being thus arranged, and the plate iodized, with one hand uncover the pan, whilst with the other, carefully put in its place the lid with the plate, and then count exactly the number of seconds required; it is advisable to turn the plate round at about half the interval that the exposition is to last, in order to equalise the action of the bromine.

"For a second operation, the small dose of bromine-water just used, must be thrown away, and replaced by a like quantity; the time will thereby remain the same for each of the plates successively, and they will be of exactly the same degree of sensitiveness.

"To these details I will add a few notes, on some difficulties which may be experienced in the use of the bromine."

"The saturated water being considered as of uniformly the same strength in the preparation of the bromine-water, you must avoid all causes which might produce an alteration in the quantity of bromine that solution contains; therefore observe particularly—first, to avoid any organic substances, such as wood, cork, &c., falling into the bottle, as, if that were the case, those substances would form a sufficient quantity of bromic acid to impair, as Mr. Foucault has remarked, the dissolving faculty of the

liquid; the bottle should therefore be closed with a ground-glass stopper. 2ndly, It is necessary to avoid leaving the bottle in the light of the sun, which might produce the same effect. 3rdly, To take care that the bromine in excess should always be considerable, as this excess is necessary to maintain at a proper degree of saturation the solution, which always becomes weaker by the unavoidable evaporation.

"The temperature and nature of the water used, provided it be not too impure, does not exercise any very important influence upon the quantity of bromine dissolved; it is therefore evidently easy to have a saturated solution of unvaried strength.

"The quantity of bromine which the normal solution contains is so inconsiderable, that the very small quantity of calcareous and other salts, which running waters hold in solution, would absorb a considerable proportion of it, if these waters were employed in their natural state. A few experiments have proved to me that the quantity absorbed by water from the Seine amounts to about one quarter of the bromine. Other kinds of water will certainly absorb a larger proportion, so that this effect must not be overlooked. If the operator had always at his disposal the same water, the preparation of the normal solution might be made, allowing for this absorption; but when travelling where the operator will find different water in each locality, he must have recourse to distilled water to obtain uniform results. I have

therefore endeavoured to find the means of using all kinds of water, without regard to their composition. It is sufficient for that purpose to neutralise, by a few drops of acid, the carbonates which appear to produce this absorption; as soon as the water exercises an acid reaction, it becomes as fit for the preparation of the bromine-water as distilled water. I must, however, remark, that such would not be the case with sulphureous waters, even were they but slightly impregnated with that mineral.

"It is necessary here to observe, that as the hyposulphites absorb bromine in a large proportion, it is indispensable to keep the hyposulphite of soda far apart from the bromine water, as the smallest quantity of this salt falling into the bromine-pan or bottle would absorb all the free bromine contained in either.

"When once you have a bottle filled with bromine-water, you may prepare successively large quantities without the use of a measure, merely by consulting its colour; for that purpose, you must have two bottles exactly alike, and always keep one full of the normal solution, and prepare in the other a solution which is brought by successive trials to precisely the same tint as the first; with a little practice, this method, which appears very inadequate to attain the object in view, is, however, susceptible of a very great degree of exactness. When travelling, in case one should lose or break the small measure, it might be of very great assistance.

"The seasons have some influence, on account of

the state of the temperature, on the tendency to evaporate which the bromine-water has; in summer, the plate should be exposed to the bromine a few seconds less than in winter. The changes of temperature having this influence, avoid exposing the bromine-pan and box in the sun, as is sometimes done during the intervals of the experiments, to cause the bromine to evaporate.

"Some precautions are necessary in the use of the evaporating-pan: 1st, It must not be greasy, in order that the bromine water may completely cover the whole of the bottom, otherwise the surface of evaporation would not be uniform; when that does occur, it must be rubbed with a very clean piece of linen cloth, with a few drops of alcohol. 2nd, Avoid, in pouring in the liquid, or in adjusting the level, allowing the bromine-water to wet the sides so as to touch the ground-glass, as, were it to come in contact with the latter, it would wet the edges of the pan, and thereby alter the regularity of the evaporation.

"The time must be exactly calculated for the exposition to the bromine, and for that in the camera; if you have not a chronometer, nothing is more convenient than pendulums formed of a little leaden ball suspended to a thread; they may be made for seconds or half seconds; the former must be 994 millimètres in length, the latter 248. When the duration of exposition in the camera is brief, it is necessary to count at least the half seconds: with the intensity of light which exists in Mr. Daguerre's normal apparatus,

it is sufficient to reckon the seconds. If you operate in the sun, sixteen to twenty-two seconds will be required; in the shade the duration will generally be comprised between forty seconds and a minute.

"When you make use of bromine, it is advisable to adapt variable diaphragms to the object-glasses, in order to obtain at will a nore rapid action or a greater degree of distinctness; but it is an indispensable condition that the surfaces of their openings should be in simple relative proportions one to the other. You may thus vary the intensity of the light in known proportions, and so obtain an identical effect, as the duration must be in an inverse ratio of the intensities. It is evident that the duration, which corresponds with each diaphragm, varies in a simple and known proportion, which allows of operating with these variable diaphragms with as much certainty as with a fixed one.

"This means has been eagerly adopted by Mr. Lemaitre, a skilful artist, who was the first to use bromine for large plates.

"One thing, which it is very important to avoid, is that of subjecting the plate to the action of the mercury in a place where the vapour of bromine is exhâled; for if, during the time that the iodized plate is being taken out of the frame and placed in the mercury-box, it were to come in contact for a single moment with the air in the slightest degree impregnated with bromine, the effect produced on the image in the camera may be so completely destroyed, that

no image can be formed on the plate by the action of the mercury.

"This effect has a tendency to be produced partially towards the edges of the plate, when it is fixed upon a frame; for in that case, the wood being slightly impregnated with bromine at the same time as the plate, emits vapours continually, which, though slight, are sufficient to destroy the action of the light on the borders of the plate. This effect will be avoided by covering the borders of the frame up to the edges with thin plates of metal; zinc or tin will answer the purpose very well.

"The iodine has the same action as the bromine, but being less volatile its effect is less to be apprehended. I think it was an action of the kind above alluded to, and not the unequal thickness of the sensitive coating, which gave the black borders to the impressions which Mr. Daguerre so successfully avoided by his metal bands. I also think that this same action satisfactorily explains the singular anomaly observed by so many operators, which consists in the almost absolute impossibility of operating with certain cameras. In almost all those cases, the iodine-box is found to have been contained in the camera; now, as the former always gives out a little of its vapour, the inside of the camera becomes impregnated with a small quantity of iodine, which continually emits some portions of it, and whilst the plate is being subjected to the action of the light, it is thus placed in contact with slight vapours of iodine,

which neutralise wholly or in part the action of the light.

"It is, therefore, advisable to prevent either the frame or camera from becoming impregnated with vapour of bromine or iodine, however slight, and if it did happen, the wood should be exposed to the open air and to the sun for some time."

MR. FOUCAULT'S BROMINE-BOX.

Mr. Foucault uses the bromine-water extremely weak, viz., the proportions of 5 grammes of bromine-water to 1000 grammes of filtered river water. His box is made of wood lined with glass, properly secured with putty, and rests upon three adjusting screws, which, together with a spirit-level, serve to bring the box to a perfect level. The height inside is about 3 centimètres; the upper part of the box is covered by a glass slide-trap, which shuts hermetically, and which is made so as to receive underneath the frame bearing the plate, which is supported by rests.

One of the side-glasses is perforated in its upper part by a hole, which allows of introducing the solution when the trap is shut; and at the bottom of the box; near one of the angles, is a little glass tube, destined to draw off the solution which has been used.

The following is the manner in which Mr. Foucault recommends it to be used:—

When the plate is iodized to the proper degree, it is placed in the frame, in which it may be left for a

very long time, even several hours, which may be very convenient when watching a favourable moment to operate, such as a ray of sunshine, or any other circumstance. When ready to operate with the bromine, fill the bottle I have before spoken of with the solution, by means of the funnel, which should be done quickly, in order that the bromine may not evaporate. Then put the funnel into the bent tube, taking care to shut the glass slide, and pour the solution rapidly into the box. It is important that the interval between the instant when you have poured the last drops into the box, and that when you draw the slide, should always be the same in each operation; half a minute, for example. This is easily done by a watch with seconds, or by counting to a certain number; at the same time, shake the box slightly, that the solution may be spread all over the bottom, and place the frame on the rests made to receive it. When the half minute is expired, draw the slide quickly; and, by means of a watch, or any other instrument for counting seconds, as it would not be sufficiently exact to depend on one's own calculation, count a certain number of seconds which must be determined for each apparatus, but limited, however, to between twenty seconds and one minute.* You will know whether the operation has lasted too long, or that the plate has absorbed too much bromine, by the impression becoming veiled or

* This number of seconds varies but little with the changes of temperature. Experience can alone point out the limits of that influence.

obscured under the influence of the mercury. In the proportion that an iodized plate absorbs bromine, its sensitiveness gradually increases up to a certain degree, beyond which the least excess causes a mist upon the proof. It is this critical point that you must reach to obtain the maximum of sensitiveness, and it is only by repeated trials that you can attain it. If you do not reach it, the plate will not be sufficiently sensitive, but this can only be known with certainty by other experiments; if you have gone beyond it, the mist or veil over the impression shows it immediately. When the proper time has elapsed, take up the plate, which place immediately in the frame, and it is then ready to receive the impression of the light.

MR. CLAUDET'S PREPARATION OF THE CHLORIDE OF IODINE.

THE chloride of iodine is prepared by bringing chlorine gas into combination with iodine. To obtain chlorine,* put into a glass retort some peroxide of manganese broken into small pieces, and upon that some hydrochloric acid. To the retort is adapted a tube twice bent: this tube communicates with a small bottle, which contains the iodine; some charcoal, or a small flame from a spirit-lamp under the retort, suffices to disengage the chlorine; the iodine becomes promptly liquefied. As soon as the

* We remind our readers that chlorine is a very deleterious substance: it is, therefore, necessary to use the greatest precautions to avoid its effects.

liquid which results from the combination has attained the colour of a bright red, the operation is terminated. The bottle must be immediately closed with great care; for that purpose, put a little tallow round the ground-glass stopper.

MANNER OF USING IT.

The chloride of iodine may be used in two different ways; pour two or three drops in a gallipot, put upon it a small quantity of cotton to retard and regulate the evaporation; and after the plate has been iodized to a golden yellow, expose it above the chloride of iodine; when it has attained a rose-colour, it is placed in the camera.

The other method is attended with one advantage, which is, that it does not occasion the development of vapours, which are disagreeable to the operator, and very pernicious, inasmuch as they attack all metals indiscriminately.

Pour a few drops of the mixture into a bottle of pure water, so as to give it the colour of Cognac brandy, and use it with the pans in the same manner as all the other substances.

Mr. Claudet has also combined chlorine with bromine, but this compound is not now in use.

PREPARATION OF THE BROMIDE OF IODINE, BY MR. T. GAUDIN.

"Pour into an alcoholic solution of iodine,* drop

* "The proportion of iodine dissolved in spirits of wine is of no importance; but it is better to employ a saturated solution."

by drop, some bromine, until the mixture becomes of a beautiful bright red; then dilute it with water, so as to produce a liquid of a bright yellow. This is the bromide of iodine ready for use, provided the proportion of bromine be proper, which practice alone can determine.

"It is earnestly recommended to those who would prepare themselves the bromide of iodine, to be on their guard against the splashing of any particles of bromine whilst pouring it into the alcoholic solution of iodine; for it is the most violent of corrosives, and the smallest particle coming into contact with the eyes will be sufficient to destroy the sight. Neither should the bromine be kept in the inhabited part of a house, lest its emanations, developed either by heat or by the breaking of the glass, should mix with the air which is breathed."

HUNGARIAN LIQUID.

This mixture has been introdued by Mr. Guerin; the recipe has not been made public. The remarkable uniformity of results obtained by the Hungarian liquid gives to it a very marked superiority. Similar in appearance to the bromide of iodine, it differs doubtless by its composition. Thus, whilst the latter requires to preserve its sensitiveness to be each day reinforced by a few drops of bromine-water, we have known the Hungarian liquid, after a considerable lapse of time, preserve such a degree of sensitiveness as to be but little inferior to the bromine-water.

MANNER OF USING IT.

It should be diluted in ten or fifteen times its volume of water, and preserved in a bottle, with ground-glass stopper.

When wanted for use, pour a small quantity of it into one of our pans, and, (the plate having been previously iodized to a rather light golden yellow,) subject it to the fumes of the liquid, consulting the colour from time to time until it has attained a light rose tint.

If small white specks were formed on the plate, it would be a proof that the mixture is too strong, and it should be further diluted with water.

There are but two preparations—Reiser's mixture and the iodide of bromine—with which the iodine-box is not necessary. We will give hereunder the manner of preparing and using them. Although seldom employed, they may be useful in case the iodine-box were broken.

ON THE IODIDE OF BROMINE.

On this subject Mr. T. Gaudin says:—

" We shall give this name to the bromide of iodine, with excess of iodine, to distinguish it from the bromide of iodine, heretofore employed after iodizing the plate. It is prepared by pouring into the bromide of iodine, with excess of bromine, an alcoholic solution of iodine until a precipitate is pro-

duced, having the appearance of iodine. To make use of it, dilute it with water until it assumes a saffron colour, and has an odour approaching that of cider.

"This compound being very variable, it is necessary to modify it every day with the alcoholic solution of iodine; or bromine water, guided in this respect by acquired experience.

"If the sensitive coating assumes an irregular appearance, it is evident that bromine is in excess; and that there is iodine in excess if the coating is not found sensitive enough."

REISER'S OR GERMAN MIXTURE.

The Reiser mixture is nothing but a chloride of iodine, of which we have given the preparation at page 105; only, instead of using it in a saturated state, it is diluted with water, and the solution used in a flat pan.

The following are the proportions given; but it is not at all necessary to conform to them strictly.

Put into a glass retort, 500 grammes of peroxide of manganese, and 250 ditto of hydrochloric acid. In the small bottle which is to receive the chlorine gas, put 90 grammes of iodine. When the iodine is liquefied, and the compound has reached a bright red tint, it is diluted in about 500 grammes of water.

It will be perceived that this liquor is nothing else than a chloride of iodine diluted with water. It has been customary, for some time past, to add bromine

to this preparation, which renders it a little more active; but it is far from having the constancy and rapidity of action of either the bromine-water at a given strength, or the Hûngarian mixture.

CHAPTER XVIII.

ON THE CONTINUATING GLASSES.

Mr. Edmond Becquerel has made numerous researches on the chemical radiations which accompany the solar and the electric light, and has arrived at this conclusion; that *rays which cannot produce a sensible impression upon a prepared substance, out of the sphere of all radiation, may continue in a very energetic manner, an action which different rays have begun to exercise upon it.* Consequently, he calls the first *exciting rays;* and the others, *continuating rays.*

Among the interesting experiments made by Mr. Edmond Becquerel, we will cite the following, for which he made use of a glass, which, when examined by the prism, only transmitted to the eye red and orange rays.

Having prepared in the dark a sheet of sensitive paper, by impregnating it successively with bromide of potassium, and then with nitrate of silver, he cut off two pieces of similar size, which he placed at the bottom of a wooden box, and then covered them entirely with a metal plate, the middle of which was

cut out so as to represent a bouquet of flowers. The whole being then covered over, and the light hermetically shut out by a wooden board, was carried before a window facing the north; he then opened and shut the obscurator, so that its exposition to the diffused light of a clouded sky did not exceed one second. When taken back into the darkened room, the two papers showed by the light of a taper some very faint traces of the image, which it was presumed ought to exist on it. The paper on which these traces were least distinct, was then placed under a sheet of red glass, and exposed to the diffused light in a northern aspect from one o'clock till five. When the apparatus was taken back into the dark room, the image of the bouquet was perfectly distinct; those parts which had received the direct action of the light, through the openings in the plate, were entirely blackened, and the other parts which had been preserved from the contact of the light, remained perfectly white, and had undergone no alteration. As to the other paper, it was still in the same state.

This experiment is conclusive, for, on the one hand, the image developed under the red glass in the absence of the object, must have existed on the paper, invisibly traced by the instantaneous action of the direct radiation. On the other hand, the part which had remained unchanged, notwithstanding the action of the red glass, must therefore have been insensible to that action. It is therefore established, that

certain rays exist, which are incapable of exercising primitively an action upon the paper, whilst these rays are very well calculated to continue that action, when it has been begun by other rays.

The importance of this discovery for the photographic art, will be easily understood by the following letter, addressed a short time afterwards to Mr. Becquerel, by Mr. Tony Gauden :—

"I have the pleasure to announce to you, that the discovery made by Mr. Edmond Becquerel, concerning the photographic action of the red rays, already so clearly proved in the report of Mr. Biot, applies perfectly to Mr. Daguerre's process, as you will be able to judge by the specimens which accompany this letter.

"Messrs. Buron and Lerebours had obtained, before I made my researches, some very remarkable results with the direct rays of the sun ; but now I can no longer doubt, that with a red light, we may be able to operate instantaneously, for I am already able to send you clouds obtained *during a high wind near the zenith, in half a second.*"

A few weeks after, Mr. Becquerel announced the fact, that the action of the yellow glass was much superior to that of the red glass on the sensitive paper ; and Mr. Tony Gaudin, then our colleague, confirmed this result, as regards silver plates.

USE OF THE CONTINUATING GLASSES.

The plate is iodized and exposed in the camera about fifteen times longer than when operating with bromine-water. On taking it thence, carefully preserving it from the least ray of light, it is put into a kind of sheath covered with yellow glass, and exposed to the direct solar radiation. The time for that exposition cannot be precisely determined; but the operation presents no difficulty, for the operator can see through the yellow glass the progress of the action. The proof is, therefore, only withdrawn when it will be found to have attained the proper point, which it is as easy to appreciate as when using the mercury-box.

By this process views may be obtained of exquisite delicacy of detail, and of a very peculiar tone.

With the accelerating substances the red glass must be used, but we have never obtained by that process results as satisfactory.

CHAPTER XIX.

COLD PROCESS FOR COLOURING AND FIXING THE PROOFS. BY MR. TONY GAUDIN.

"Dissolve one gramme of chloride of gold in half a litre of ordinary water, and thirty grammes of hyposulphite of soda in another half litre of similar water; then pour the solution of chloride of gold into that of soda by little and little, agitating it exactly as in Mr. Fizeau's preparation, of which this is but a variation.

"When you wish to use it, pour some into a plate, or any other vessel of the same kind, sufficient to cover the proof; then, after having added to it a drop of ammonia, immerse the plate in it as soon as you take it out of the mercury-box, after having wiped its back and edges, and agitate the mixture quickly from right to left, so as to dissolve rapidly the coating of iodide of silver as usual. As soon as the plate appears white, cease all rapid motion, but continue to give it a slight undulating one; for if it were allowed to remain still for only a few minutes the proof would be clouded. By little and little the surface of the plate takes a yellow tint, which darkens more and more, approaching to bistre. You stop, therefore, at the colour you wish; and when the proof has been washed and dried in the

manner previously explained, it will be found to be fixed, without any stain, with a limpid surface, and an extraordinarily warm tone. If you were to augment the proportions of the ammonia or chloride of gold, the operation would progress much quicker; but then the middle of the proof would be always much clearer than towards the border. The mixture may be used several times without being renewed; it does not, however, give such a beautiful colour to the impressions as when it is newly prepared. By communicating to the vessel containing the solution a continual motion, the impression, when once immersed, will be fixed. During that time, and whilst attending to anything else, watch its colour, and at the end of ten minutes, or a quarter of an hour, take it out of the bath and dry it."

END OF THE THIRD PART

FOURTH PART.

CHAPTER XX.

ON THE REPRODUCTION OF THE PROOFS BY THE ELECTROTYPE.

The first impressions reproduced by the electrotype were obtained by Mr. H. Fizeau; and we may say, that these first essays have not been since surpassed, for the large plates that he produced were admirable.

We imagine that many amateurs, when informed of the extreme facility with which they can now operate, by means of the new batteries invented by Bunsen, will devote themselves to this species of reproduction, which gives such fine results. We must confine ourselves here to pointing out to them the minute precautions which are necessary to avoid spoiling the original plate and its copy. Two apparatus are necessary to obtain a reproduction: 1st, One of Bunsen's cells; 2nd, A glass precipitating-trough, to contain a saturated solution of sulphate of copper.*

* The electrotype of Boquillon may also be used; but only for the plates of the 1-6th size.

The plate must first be entirely divested of all traces of hyposulphite, and it is *indispensable* that it should be perfectly fixed by the chloride of gold.

In general, operators are in a hurry to see the progress of the process. We advise them to moderate that eagerness which is frequently the cause of failure. They should always wait a few minutes before taking the plate out of the bath; and, each time that it is done, care must be taken not to leave it long in contact with the air, as a few minutes would suffice to oxydize the surface to such a degree as to hinder the next deposite from adhering to the first.

When the metallic coating is judged to be of sufficient thickness—and, in this case, that of a stout card suffices—the plate should be rinsed copiously in water, and then dried either with saw-dust or blotting-paper. If you wish to preserve on the plate the beautiful rosy hue of the mother-of-pearl opal, which the deposite should leave on its being taken out of the bath, hasten the drying of it, after passing it once through the water, by wetting it with spirits of wine, which you also dry up with blotting-paper.

The separation of the deposite from the plate may be attended with an accident which spoils them both. It often happens that a small drop of liquid remains unperceived under the wax which covers the borders of the plate, and that, at the instant when you lift up the deposite with the blade of a knife, this drop works itself into the capillary space thus formed, and wets the deposite and the plate, which are infallibly stained

if the liquid contains any remaining particles of the sulphate of copper.

The most secure process for separating the two plates consists, when the deposite is not too thick, in cutting with a pair of strong scissars a band of about two millimètres in width all round the two plates, which then separate with the greatest facility.

The affinity of oxygen for copper being much greater than for silver, the counter-proof must be withdrawn as soon as possible from the contact of the air, by placing it in a skeleton frame; and, above all, the greatest care must be taken not to touch its surface with anything whatsoever. It is, moreover, necessary to observe the nicest precaution in preventing all dust or other foreign substances from lodging on the surface of the plate, otherwise the copy would be found disfigured with their corresponding traces.

Having thus explained the most essential conditions to be observed, we will now enter into some further details of the operation. Lay hold of the silvered plate by one of its sides, or, if a small plate, by one of its angles, and keep that part free from oxidation, in order to attach it to the connecting wire of the trough, to which the positive pole (zinc) of the battery is joined, and the whole is held fast with a binding-screw.

The back of the plate is then covered with a coating of varnish, composed of one-third of essence of turpentine and two-thirds of beeswax, or simply of beeswax alone, in order to avoid a useless deposite of

copper. Care must be taken that this coating of varnish, which should be applied hot, should be of a certain thickness, and should not interpose between the plate and the connecting wire of the precipitating trough, or it would interrupt the metallic contact necessary to the success of the operation.

The sulphate of copper solution must be carefully filtered, and it must be saturated in cold water.*

When all is prepared, put the positive electrode (a copper plate, which dissolves in the trough) in connexion with the negative pole of the battery (carbon), and immerse it in the bath ; establish also a connexion between the proof to be reproduced and the other pole (zinc), and when firmly attached by means of one or more binding-screws, it must be immersed in the bath, when it will immediately become covered with copper.

A single battery of Bunsen charged outside with pure nitric acid, and with a mixture composed of one part of sulphuric acid and fifty parts of water in the interior of the porous vessel will suffice to reproduce, in the space of a few hours, a large plate of 16 centimètres by 0,22. The expense consists, therefore, only in the value of the copper deposited ; and when it is considered that, with so very small an outlay, you may be able, after one or two experiments, to

* In order to have a solution always ready, it will be well to keep it in a large glass-bottle ; it will be known that it is sufficiently saturated, when after having shaken it several times, the liquid ceases to dissolve the few crystals of sulphate of copper which remain at the bottom in excess.

reproduce and multiply, without any risk of failure, the finest photographic impressions (which are always very much prized), with a very warm tone, and an admirable degree of perfection; when you reflect that the same small apparatus may serve for a number of other applications, one is really surprised that it should not be more generally adopted.*

The new processes employed for superposing one metal on another must excite in the highest degree the attention of all those who take an interest in the industrial arts. What a valuable discovery is not that which enables us to apply, in the most simple and economical manner, gold upon steel, copper, and silver—the latter metal upon tin and iron—platina upon copper, bronze, &c.!

Most of these applications will create new arts: it is not our province to enter upon that subject here. However, as a very fine tone may be given to the Daguerreian impressions by gilding, I will inform the

* The *reproduction* in copper or silver, whether polished or dead, of a medal, seal, or cameo, &c., are operations which cannot fail to be agreeable to most persons in easy circumstances; as it enables them to obtain, at a merely nominal price, an object of art which has often a great value, it being, at the same time, a pleasing occupation, which diverts the mind during the intervals between more serious studies. Plaster-casts, fruits, insects, and certain flowers, may also be *covered over* with copper, by this process, and afterwards gilt or plated.

We hope these instructions will suffice to reproduce the Daguerreian images; but those who would wish to make a particular study of the laws by which metallic precipitations are produced, must procure the complete Treatise on the Electrotype by Mr. L. . . . , sold by N. P. Lerebours, 13, Place du Pont-Neuf, Paris.

reader how I applied this process so as to produce the *first gilt photogenic image* attempted by this art.

In the month of August, 1841, being at the time unacquainted with Messrs. Ruolz and Elkington's patents for their new gilding processes, but anxious to know how the admirable chloride of gold, which we owe to Mr. Fizeau, would act in a cold process, I placed a Daguerreian impression in an electrotype; and, to my great surprise and delight, I found, at the end of a quarter of an hour, that it had acquired a superb gold tone! As may be easily imagined, I immediately showed this result to Mr. Boquillon; and, having expressed to that gentleman a wish to submit it on the following Monday to the Institute, he led me to infer that this result, confirming as it did certain theoretic laws, some important applications of which he was then testing by various experiments, was peculiarly interesting to him. This was sufficient to induce me to withhold my intended communication to the Institute; and I accordingly confined myself to addressing a letter to Mr. Arago, with a specimen, merely to fix the date of my discovery.* Since then, I have made various experiments with different salts of gold. The only one which succeeded, with the electrotype, was Mr. Fizeau's mixture (the chloride of gold and the hyposulphite of soda). It is doubtless to the ener-

* A short time after he made his communication to the Institute, Mr. De Ruolz was good enough to gild several plates for me; these impressions were of a very fine gold tone, rather dark, and inclined to red.

getic action of this solution, that this astonishing result must be attributed; for, whether with Smee's battery or Bunsen's element, the gilding I obtained with this same salt, did not give me a superior result; and yet the double cyanides used with the last apparatus gave a much richer tone than the chloride of gold; but with the electrotype, I repeat it, the chloride of gold alone gave me excellent results.

To operate with the electrotype, the following is the method of manipulating: instead of the sulphate of copper, pour in Mr. Fizeau's solution, and very slightly acidulate the liquid in which the zinc is immersed; a few minutes will suffice for this operation, which must be attentively watched, often examining the formation of the coating of gold deposited; for, if the operation were too much prolonged, the thickness of that coating would successively efface all the half-tints, and would consequently destroy the beauty of the impression.

With the decomposing trough, and Bunsen's or any other battery, you must operate exactly as with a sulphate of copper bath. If you wish to maintain the gold solution in a saturated state, immerse in it, at a certain distance from the plate, a thin sheet of gold, which must be connected with the negative pole. If otherwise, you have merely to immerse in the bath a platina wire, which must be moved about in it, and, when the action is rapid, at a distance from the plate.

A deposite of copper upon the plate thus gilt may be obtained; but this counter-proof will naturally be less vigorous, because this layer of gold, however thin it may be, always weakens a little the extremely delicate details of the Daguerreian image.

CHAPTER XXI.

ON ENGRAVING.

The idea of transforming the Daguerreian images obtained on the silvered plates into engraved plates, so as to multiply them by impression, must have struck a great number of persons: we can affirm that it is Mr. Donné who was the first to obtain a somewhat satisfactory result. The following is the manner in which he operated:*—

After having gone through the washing process in the ordinary way, taking care to use a rather weak

* Mr. Fizeau, so well known for his admirable discoveries in photography, has just found out a process for engraving the Daguerreian plates, which is very superior to any hitherto known. We have seen some of the proofs struck off, without any particular care, by a workman of ordinary ability, and we can affirm that the most of these engravings, when seen through a magnifying-glass, showed the exact representation of the Daguerreian image, with its most minute details. Moreover, in the proofs which have been submitted to our examination, the dark parts of the picture were reproduced with a great degree of vigour, and, what is very remarkable, the white parts of the paper were perfectly pure. When one reflects on the future results of this discovery, one cannot be surprised that Mr. Fizeau should have wished to keep it secret. For our own part, it would be of immense utility to us for the publication of the *Daguerreian*

solution, the plate, which should be faultless, and containing at least one-twentieth of silver, should be dried, and its edges beyond the image covered with a coating of engraver's varnish.

Place the plate horizontally over a pan, on which its four angles rest, and pour upon it, in such a manner as to cover all the unvarnished parts, a rather thin liquid coating, being a solution containing three parts of *pure* nitric acid and four parts of water.

At the end of three or four minutes, small globules will begin to appear at different points, and will at last spread over all the parts of the plate. It is here that the greatest difficulty presents itself, for, nothing but experience can point out the moment at which the plate is sufficiently acted upon by the acid. If you cease the operation too soon, the blacks will be without vigour and of a gray tone; if prolonged beyond the necessary time, even the whites will be affected; thus the operator has two difficulties to contend with. Mr. Donné has pointed out an ingenious method of solving these difficulties, which he has found frequently to succeed; it consists in blowing off the acid with the breath from all the white parts, in order to preserve them. This method is doubtless very good, but can only be used when the lights are

Excursions; for, with its aid, we might immediately reproduce, at very small expense, the remarkable views which our correspondents are continually sending us; and, in order to avoid any greater or lesser alteration in the press, we should immediately reproduce several plates by the electrotype.

accumulated on one point, which is very seldom the case.

Dr. J. Berres has given a process for etching, which has much analogy to that of Mr. Donné, from which it only differs in this, that Mr. Donné operates with a mixture of nitric acid, whilst Dr. Berres begins by exposing the plate to the vapours of nitric acid, slightly heated, and after having covered over with a varnish those parts which are to be protected, he covers the plate with a coating of gum arabic, which he afterwards melts in nitric acid at a strength of twelve or thirteen degrees, and which he augments progressively to sixteen or eighteen degrees. When the vapours are manifested, the plate is engraved.

This process, which we have never practised, appears to us to require a certain skilfulness in protecting the white parts and covering them with varnish, and in seizing the moment at which the plate is sufficiently eaten into by the acid; but we think that none but an engraver can expect to succeed in it.

CHAPTER XXII.

ON A VOLTAIC PROCESS FOR ETCHING DAGUERREOTYPE PLATES. BY W. R. GROVE, ESQ., M.A., F.R.S., PROFESSOR OF EXPERIMENTAL PHILOSOPHY IN THE LONDON INSTITUTION.

Dr. Berres, of Vienna, was the first, I believe, who published a process for etching daguerreotypes. His method was to cover the plates with a solution of gum-arabic, and then to immerse them in nitric acid of a certain strength. I have not seen any plates thus prepared, but the few experiments which I have made with nitric acid have given me a burred and imperfect outline: and I have experienced extreme difficulty of manipulation from the circumstance of the acid never attacking the plate uniformly and simultaneously. My object, however, in this communication, is not to find fault with a process which I have never perhaps fairly tried or seen tried by experienced hands, and the inventor of which deserves the gratitude of all interested in physical science; but to make public another, which possesses the advantage of extreme simplicity, which any one, however unskilled in chemical manipulation, may practise with success, and which produces a perfect etching of the original image; so much so, that a plate thus etched can scarcely be distinguished from an actual daguer-

reotype, preserving all the microscopic delicacy of the finest parts of the impression.

One sentence will convey the secret of this process; it is to make the daguerreotype the *anode** of a voltaic combination, in a solution which will not of itself attack either silver or mercury, but of which. when electrolysed, the anion will attack these medals unequally. This idea occurred to me soon after the publication of Daguerre's process; but, being then in the country, and unable to procure any plates, I allowed the matter to sleep; and other occupations prevented for some time any recurrence to it. Recently having heard much conversation as to the practicability or impracticability of daguerreotype engraving, I became anxious to try a few experiments in pursuance of my original notion; and for this purpose applied in several quarters for daguerreotypes; but, thanks to the exclusiveness of M. Daguerre's patent, I found that to procure a sufficient number of plates for any reasonable chance of success was quite out of the question.

On mentioning the subject to Mr. Gassiot, he, with his usual energy and liberality, offered to procure me a sufficiency of daguerreotypes; and it is owing to his zealous and valuable co-operation that I have been

* Strictly speaking, this is a misapplication of Faraday's term; he applied it to the surface of the electrolyte. As, however, all Continental and many English writers (among whom I may name Whewell) have applied it to the positive electrode, and as an expression is most needed for that, I have not hesitated so to apply it.

able to get such definite results as appear worth publication.

Five points naturally present themselves to the consideration of the experimenter on this subject :— first, the quantity of the voltaic current; secondly, its intensity; thirdly, the distance between the anode and cathode; fourthly, the time during which the process should be continued; and fifthly, the solution to be employed.

1st. With regard to the first element, or quantity, many previous experiments had convinced me, that to give the maximum and most uniform quantitative* action of any voltaic combination, the electrodes should be of the same size as the generating plates; in other words, that the sectional area of the electrolyte should be the same throughout the whole voltaic circuit. It seems strange that this point should have been so generally overlooked as it has been: an electrician would never form a battery, one pair of plates of which were smaller than the rest; and yet the electrodes, which offering of themselves a resistance to the current, from the inoxidability of the anode, are, *à fortiori*, a restriction when of small size, have generally been formed indefinitely smaller than the generating plates; I, therefore, without further experiment, applied this principle to the process about to be detailed.

* I say quantitative action; for, where great intensity is required, as in decomposing alkalis, &c., it may be advisable to narrow the electrodes, so as to present a smaller surface for the reaction of the liberated elements.

2nd. *The intensity of the voltaic current.*—Here it appeared to me, that, as in the electrotype, where the visible action is at the cathode, a certain degree of intensity throws down metal as a crystal, an increased intensity as a metallic plate, and a further intensity as a pulverulent mass; that degree of intensity which would show on the negative deposite the finest impressions from the cathode, would also produce on the anode the most delicate excavations, and consequently an intensity which would just fall short of the point of evolving oxygen from the plate to be etched, would be the most likely to succeed. This point was not, however, adopted without careful experiment, the more so, as in one instance Mr. Gassiot succeeded in procuring a very fair etching with a series of ten pairs of the nitric acid battery; however, the results of repeated experiments, in which the intensity has been varied from a series of sixteen pairs to one of the nitric acid battery, were strongly in favour of the above idea, and consequently went to prove that one pair gives the most efficient degree of intensity for the purpose required.

3rd. *The distance between the plates.*—As it was proved by De la Rive, that in an electrolytic solution, when the electrodes are at a distance, the action extends a little beyond the parallel lines which would join the bounds of the electrodes, and thus, that the current as it were diverges and converges, it appeared advisable to approximate the electrodes as nearly as possible, so as to produce uniformity of

action over the whole plate. Provided a solution be used which does not evolve gas at the cathode, I am inclined to think that the plates may be with advantage indefinitely approximated; but as this was not the case with the solution I selected for the greater number of experiments, 0·2 of an inch was fixed on as the distance, in order that the gas evolved from the cathode should not adhere to the anode, and thus interfere with the action.

4. *Time of continuing the operation.*—This was a matter only to be decided by experiment, and must vary for the voltaic combination and solution employed. With a single pair of the nitric acid battery, from twenty-five to thirty seconds was, after a great number of experiments, fixed on as the proper time; and as the plate may at any period be removed from the solution and examined, the first experiment should never exceed twenty-five seconds, when, if not complete, the plate may be again subjected to electrolysis.

5. *The solution to be employed.*—Here a vast field was open, and still is open to future experimentalists. Admitting the usual explanation of the daguerreotype, which supposes the light parts to be mercury, and the dark silver, the object was to procure a solution which would attack one of these, and leave the other untouched. If one could be found to attack the silver and not the mercury, so much the better; as this would give a positive engraving, or one with the lights and shadows, as in nature;

while the converse would give a negative one. Unfortunately, silver and mercury are nearly allied in their electrical relations. I made several experiments with pure silver and mercury, used as the anode of a voltaic combination; but found, that any solution which would act on one, acted also on the other. All then that could be expected, was a difference of action. With the daguerreotype plates I have used the following:—

Dilute sulphuric acid, dilute hydrochloric acid, solution of sulphate of copper, of potash, and of acetate of lead. The object of using acetate of lead, was the following:—With this solution, peroxide of lead is precipitated upon the anode; and, this substance being insoluble in nitric acid, it was hoped that the pure silver parts of the plate, being more closely invested with a stratum of peroxide than the mercurialised portions, these latter would, when immersed in this menstruum, be attacked, and thus furnish a negative etching. I was also not altogether without hopes of some curious effects, from the colour of the thin films thus thrown down; here, however, I was disappointed: the colours succeeded each other much as in the steel plate used for the metallochrome; but with inferior lustre. On immersion in nitric acid of different degrees of dilution, the plates were unequally attacked, and the etching burred and imperfect. Of the other solutions, hydrochloric acid was, after many experiments, fixed on as decidedly the best: indeed, this I expected, from the strong affinity of chlorine for silver.

I will now describe the manipulation which has been employed by Mr. Gassiot and myself, in the laboratory of the London Institution, with very uniform success. A wooden frame is prepared, having two grooves at 0·2 of an inch distance, into which can be slid the plate to be etched, and a plate of platinum of the same size. To ensure a ready and equable evolution of hydrogen, this latter is platinised after Mr. Smee's method; for, if the hydrogen adhere to any part of the cathode, the opposite portions of the anode are proportionably less acted on. The back and edges of the daguerreotype are varnished with a solution of shell-lac, which is scraped off one edge to admit of metallic connection being established. The wooden frame with its two plates, is now fitted into a vessel of glass or porcelain, filled with a solution of two measures hydrochloric acid, and one distilled water (sp. gr. 1·1); and two stout platinum wires, proceeding from a single pair of the nitric acid battery, are made to touch the edges of the plates, while the assistant counts the time; this, as before stated, should not exceed thirty seconds. When the plate is removed from the acid, it should be well rinsed with distilled water; and will now (if the metal be homogeneous) present a beautiful sienna-coloured drawing of the original design, produced by a film of the oxychloride formed;—it is then placed in an open dish containing a very weak solution of ammonia, and the surface gently rubbed with very soft cotton, until all the deposite is dissolved; as

soon as this is effected, it should be instantly removed, plunged into distilled water, and carefully dried. The process is now complete, and a perfect etching of the original design will be observed; this, when printed from, gives a positive picture, or one which has its lights and shadows as in nature; and which is, in this respect, more correct than the original daguerreotype, as the sides are not inverted; printing can therefore be directly read, and in portraits thus taken, the right and left sides of the face are in their proper position. There is, however, *ex necessitate rei*, this difficulty, with respect to prints from daguerreotypes,—if the plates be etched to a depth sufficient to produce a very distinct impression, some of the finer lines of the original must inevitably run into each other, and thus the chief beauty of these exquisite images be destroyed. If, on the other hand, the process be only continued long enough to leave an exact etching of the original design, which can be done to the minutest perfection, the very cleaning of the plate by the printer destroys its beauty; and, the molecules of the printing ink being larger than the depths of the etchings, an imperfect impression is produced. For this reason, it appeared to me, that at present, the most important part of this process is the means it offers of multiplying indefinitely daguerreotypes, by means of the electrotype. An ordinary daguerreotype, it is known, will, when electrotyped, leave a faint impression; but in so doing it is entirely destroyed; and this impression cannot

be perpetuated; but one thus etched at the voltaic anode, will admit of any number of copies being taken from it. To give an idea of the perfect accuracy of these, I may mention, that in one I have taken, on which is a sign-board measuring on the electrotype plate 0·1 by 0·06 of an inch, five lines of inscription can, with the microscope, be distinctly read. The great advantages of the voltaic over the chemical process of etching, appear to me to be the following:—

1. By the former, an indefinite variety of menstrua may be used; thus, solutions of acids, alkalies, salts, more especially the haloid class, sulphurets, cyanurets, in fact, any element which may be evolved by electrolysis, may be made to act upon the plate.

2. The action is generalised; and local voltaic currents are avoided.

3. The time of operation can be accurately determined; and any required depth of etching produced.

4. The process can be stopped at any period, and again renewed if desirable.

The time I have given is calculated for experiments made with one pair of the nitric acid battery; it is, however, by no means necessary that this be employed, as probably any other form of voltaic combination may be efficient. It would seem more advisable to employ a diaphragm battery, or one which produces a constant current, as otherwise the time cannot be accurately determined. It is very necessary that the silver of plates subjected to this process be homo-

geneous. Striæ, imperceptible in the original daguerreotype, are instantly brought out by the action of the nascent anion; probably silver, formed by voltaic precipitation, would be found the most advantageous. I transmit with this paper some specimens of the prints of the etched plates, and of electrotypes taken from them; and in conclusion, would call attention to the remarkable instance which these offer, of the effects of the imponderable upon the ponderable: thus, instead of a plate being inscribed, as "drawn by Landseer, and engraved by Cousins," it would be "drawn by Light, and engraved by Electricity!"

[With this communication were sent plates etched by the process detailed in the text; electrotype copies from the same; and a considerable number of prints obtained from the former.]

Postscript by the Author.—Few of the readers of the Philosophical Magazine will have an opportunity of seeing any specimens of the process, and as the etching is not deep enough to produce impressions sufficient to accompany the paper, I may give an idea of them by saying that in the print of a portrait which I have now before me, the whole expression of the features is distinct, the pupil of the eye and the speck of light upon it clearly defined, the gloss of the hair and of the satin stock very accurate. The microscopic details alone appear

incapable of transference to *paper*, but these, as stated above, being *absolutely perfect* upon the etched plate, I had intended to have directed some experiments to the substitution of more delicate materials than paper and printing-ink for receiving the impressions; incessant occupations have prevented me, and will I fear for some time.

I would suggest the employment of hyposulphite of soda instead of ammonia to remove the oxychloride. —W. R. G.

CHAPTER XXIII.

PHOTOGENIC PAPERS.—ON THE CALOTYPE, BY H. F. TALBOT, ESQ., F.R.S.*

The following is the method of obtaining the Calotype pictures:—

Preparation of the Paper.—Take a sheet of the best writing paper, having a smooth surface, and a close and even texture.

The water-mark, if any, should be cut off, lest it should injure the appearance of the picture. Dissolve 100 grains of crystallised nitrate of silver in six ounces of distilled water. Wash the paper with this solution,

* Mr. Talbot has had the kindness to make me a present of several of his photogenic copies: some of them are of an admirable tone, and of a very fine effect. One cannot help regretting, on seeing them, that the reproduction of photographic images on paper is not more practised in our country.

with a soft brush, on one side, and put a mark on that side whereby to know it again. Dry the paper cautiously at a distant fire, or else let it dry spontaneously in a dark room. When dry, or nearly so, dip it into a solution of iodide of potassium containing 500 grains of that salt dissolved in one pint of water, and let it stay two or three minutes in this solution; then dip it into a vessel of water, dry it lightly with blotting-paper, and finish drying it at a fire, which will not injure it even if held pretty near: or else it may be left to dry spontaneously.

All this is best done in the evening by candlelight. The paper so far prepared the author calls *iodized paper*, because it has a uniform pale yellow coating of iodide of silver. It is scarcely sensitive to light, but, nevertheless, it ought to be kept in a portfolio or a drawer, until wanted for use. It may be kept for any length of time without spoiling or undergoing any change, if protected from the light. This is the first part of the preparation of Calotype paper, and may be performed at any time. The remaining part is best deferred until shortly before the paper is wanted for use. When that time is arrived, take a sheet of the iodized paper, and wash it with a liquid prepared in the following manner:—

Dissolve 100 grains of crystallised nitrate of silver in two ounces of distilled water; add to this solution one-sixth of its volume of strong acetic acid. Let this mixture be called A.

Make a saturated solution of crystallised gallic acid

in cold distilled water. The quantity dissolved is very small. Call this solution B.

When a sheet of paper is wanted for use, mix together the liquids A and B in equal volumes, but only mix a small quantity of them at a time, because the mixture does not keep long without spoiling. I shall call this mixture the gallo-nitrate of silver.

Then take a sheet of iodized paper and wash it over with this gallo-nitrate of silver, with a soft brush, taking care to wash it on the side which has been previously marked. This operation should be performed by candlelight. Let the paper rest half a minute, and then dip it into water. Then dry it lightly with blotting-paper, and finally dry it cautiously at a fire, holding it at a considerable distance therefrom. When dry, the paper is fit for use. The author has named the paper thus prepared Calotype paper, on account of its great utility in obtaining the pictures of objects with the camera obscura. If this paper be kept in a press it will often retain its qualities in perfection for three months or more, being ready for use at any moment; but this is not uniformly the case, and the author therefore recommends that it should be used in a few hours after it has been prepared. If it is used immediately, the last drying may be dispensed with, and the paper may be used moist. Instead of employing a solution of crystallised gallic acid for the liquid B, the tincture of galls diluted with water may be used, but he does not think the results are altogether so satisfactory.

Use of the Paper.—The Calotype paper is sensitive to light in an extraordinary degree, which transcends a hundred times or more that of any kind of photographic paper hitherto described. This may be made manifest by the following experiment:—Take a piece of this paper, and having covered half of it, expose the other half to daylight for the space of one second in dark cloudy weather in winter. This brief moment suffices to produce a strong impression upon the paper. But the impression is latent and invisible, and its existence would not be suspected by any one who was not forewarned of it by previous experiments.

The method of causing the impression to become visible is extremely simple. It consists in washing the paper once more with the gallo-nitrate of silver, prepared in the way before described, and then warming it gently before the fire. In a few seconds the part of the paper upon which the light has acted begins to darken, and finally grows entirely black, while the other part of the paper retains its whiteness. Even a weaker impression than this may be brought out by repeating the wash of gallo-nitrate of silver, and again warming the paper. On the other hand, a stronger impression does not require the warming of the paper, for a wash of the gallo-nitrate suffices to make it visible, without heat, in the course of a minute or two.

A very remarkable proof of the sensitiveness of the Calotype paper is afforded by the fact stated by the author, that it will take an impression from simple

moonlight, not concentrated by a lens. If a leaf is laid upon a sheet of the paper, an image of it may be obtained in this way in from a quarter to half an hour.

This paper being possessed of so high a degree of sensitiveness, is therefore well suited to receive images in the camera obscura. If the aperture of the object-lens is one inch, and the focal length fifteen inches, the author finds that one minute is amply sufficient in summer to impress a strong image upon the paper of any building upon which the sun is shining. When the aperture amounts to one-third of the focal length, and the object is very white, as a plaster bust, &c., it appears to him that one second is sufficient to obtain a pretty good image of it.

The images thus received upon the Calotype paper are for the most part invisible impressions. They may be made visible by the process already related, namely, by washing them with the gallo-nitrate of silver, and then warming the paper. When the paper is quite blank, as is generally the case, it is a highly curious and beautiful phenomenon to see the spontaneous commencement of the picture, first tracing out the stronger outlines, and then gradually filling up all the numerous and complicated details. The artist should watch the picture as it develops itself, and when in his judgment it has attained the greatest degree of strength and clearness, he should stop further progress by washing it with the fixing liquid.

The Fixing Process.—To fix the picture, it should be first washed with water, then lightly dried with

blotting-paper, and then washed with a solution of bromide of potassium, containing 100 grains cf that salt dissolved in eight or ten ounces of water. After a minute or two it should be again dipped in water, and then finally dried. The picture is in this manner very strongly fixed, and with this great advantage, that it remains transparent, and that, therefore, there is no difficulty in obtaining a copy from it. The Calotype picture is a negative one, in which the lights of nature are represented by shades; but the copies are positive, having the lights comformable to nature. They also represent the objects in their natural position with respect to right and left. The copies may be made upon Calotype paper in a very short time, the invisible impressions being brought out in the way already described. But the author prefers to make the copies upon photographic paper prepared in the way which he originally described in a memoir read to the Royal Society, in February 1839, and which is made by washing the best writing paper, first with a weak solution of common salt, and next with a solution of nitrate of silver. Although it takes a much longer time to obtain a copy upon this paper, yet when obtained, the tints appear more harmonious and pleasing to the eye; it requires in general from three minutes to thirty minutes of sunshine, according to circumstances, to obtain a good copy on this sort of photographic paper. The copy should be washed and dried, and the fixing process (which may be deferred to a subsequent day) is the same as that already mentioned.

The copies are made by placing the picture upon the photographic paper, with a board below and a sheet of glass above, and pressing the papers into close contact by means of screws or otherwise.

After a Calotype picture has furnished several copies, it sometimes grows faint, and no more good copies can then be made from it. But these pictures possess the beautiful and extraordinary property of being susceptible of revival. In order to revive them and restore their original appearance, it is only necessary to wash them again by candlelight with gallo-nitrate of silver, and warm them: this causes all the shades of the picture to darken greatly, while the white parts remain unaffected. The shaded parts of the paper thus acquire an opacity which gives a renewed spirit and life to the copies, of which a second series may now be taken, extending often to a very considerable number. In reviving the picture, it sometimes happens that various details make their appearance which had not before been seen, having been latent all the time, yet nevertheless not destroyed by their long exposure to sunshine.

The author terminates these observations by stating a few experiments, calculated to render the mode of action of the sensitive paper more familiar.

1. Wash a piece of the iodized paper with the gallo-nitrate; exposing it to daylight for a second or two, and then withdraw it. The paper will soon begin to darken spontaneously, and will grow quite black.

2. The same as before, but let the paper be

warmed. The blackening will be more rapid in consequence of the warmth.

3. Put a large drop of the gallo-nitrate on one part of the paper and moisten another part of it more sparingly, then leave it exposed to a very faint daylight; it will be found that the lesser quantity produces the greater effect in darkening the paper; and in general, it will be seen that the most rapid darkening takes place at the moment when the paper becomes nearly dry; also, if only a portion of the paper is moistened, it will be observed that the edges or boundaries of the moistened part are more acted on by light than any other part of the surface.

4. If the paper, after being moistened with the gallo-nitrate, is washed with water and dried, a slight exposure to daylight no longer suffices to produce so much discoloration; indeed it often produces none at all. But by subsequently washing it again with the gallo-nitrate and warming it, the same degree of discoloration is developed as in the other case (experiments one and two). The dry paper appears, therefore, to be equal, or superior in sensitiveness to the moist; only with this difference, that it receives a virtual instead of an actual impression from the light, which it requires a subsequent process to develope.

The above communication from Mr. Talbot was made to the Academy by Mr. Biot, who, at the same time, announced, that he had placed the specimens of sensitive papers sent by Mr. Talbot, in the hands of Mr. Regnault, member of the Academy, who has long

devoted his attention to the production of Daguerreian images, in which he has been very successful. Mr. Biot adds the following remarks :—

"As the impressionable papers are destined to become of great utility to travellers, it will not be uninteresting to show that their use may be much improved, if the following precautions are taken :—

"1st. To prepare them always with paper of a very uniform texture.

"2ndly. To adapt to the camera object-glasses, which are not achromatic for the light; but the curves of which are calculated so as to collect, in one focus, all the invisible radiations which act most efficaciously on the impressionable substance employed in their preparation.

"3rdly. To keep them for a very few instants in presence of the objects to be represented, and to continue the development of the image out of their presence, by the influence of the solar radiation, transmitted through a red-glass, in conformity with the singular property which the latter possesses, and which was so ingeniously discovered by Mr. Edmund Becquerel.

MR. BAYARD'S PAPER.

It is well known that, for many years past, Mr. Bayard has been in the habit of obtaining splendid proofs on various sensitive papers, of which he has reserved the copyright. In 1839, the Academy of Fine

Arts announced the admirable discovery made by Mr. Bayard, in the following terms:—

"From the details into which we have just entered, the Academy, which has already been able to appreciate the merit of Mr. Bayard's images, is also enabled to judge of the degrees of improvement through which a process, which cannot yet have reached its highest perfection, has passed in so short a time. But, even were it to be considered, from the present time, as an invention already carried out to its furthest limits, what it is most important to know in all its details, are the properties which characterise Mr. Bayard's discovery, and the advantages which must render it precious for the arts.

"The Academy already knows that the proofs due to Mr. Bayard's process, are produced upon paper, by means of a preparation, which constitutes in great part the secret of the process. The quality of the paper that he judges most proper for insuring the success of his operation, is that of fine machine paper. He prefers white to coloured paper, because the latter loses its colour unequally, in consequence of the preparation which it undergoes, whence result blemishes, which are injurious to the picture; whilst white paper acquires, by that very preparation, a colour which, beginning at the red tint, and passing through all the bistre tints, to arrive at the neuter tint, approaching to blue, produces a very agreeable general effect.

"Add to that, that the pictures produced by this

process possess the property of being preserved like water-colour drawings, from the moment that they have been fixed on the paper by a washing process; they may be carried about on a journey, kept in a portfolio, passed from hand to hand, without experiencing any alteration by time, and without being effaced by contact with other bodies.

"We have had a proof of this by the state in which we have found the greater part of Mr. Bayard's pictures, which have already been in circulation two or three months, without having experienced any sensible alteration: in order that they may retain all their vigour, it suffices that they be not exposed to the direct effect of too strong a light. They are, consequently, really drawings, both as regards their facility of preservation and the use that may be made of them; they are only destroyed by that which destroys every species of picture made by the hand of man—by that which produced them—light and time!

"The images are in their proper positions, which is another of the principal features of the process.

"Up to the present time, the applications of the process have been made principally to masses of buildings, details of interiors, works of art, statues, busts, figures, &c., which have all been reproduced with as much truth as effect. Amongst other applications, of which its author thinks it susceptible, and which he has tried with more or less success, we shall only mention that which consists in reproducing

objects imperceptible to the naked eye, when seen and magnified by the solar microscope.*

"But one of the applications which we think belongs exclusively to Mr. Bayard's invention, and which would be of great utility for the art and those who cultivate it, would be the reproduction of prints, which our author has already practised with success."†

Mr. Verignon‡ has brought out a photographic paper, which produced very pleasing results with the camera; but, unfortunately, like most of the other papers invented, it is not highly sensitive; and this is what has induced him to give up its manufacture.

The following is the way to prepare it:—

The white paper must first be washed with water acidulated with hydrochloric acid; then, after its dessication, passed through a solution prepared in the following manner:—14 parts of water to 1 of a

* "Reproductions on paper may possess for certain objects of art a much greater charm than the Daguerreian pictures. The remarkable results obtained by Mr. Bayard leave no doubt in this respect. With an additional degree of expedition it will, perhaps, be possible to arrive at the taking of admirable portraits and views of a very fine effect. But, for all those objects which require a high degree of finish in the details, the pictures on paper will never be able to support a comparison with those on the silvered plates; the fibrous texture of the former will always be an insurmountable obstacle to perfection in reproductions of this nature."—(*Note by N. P. Lerebours.*)

† The advantage possessed by Mr. Bayard's paper, over that of Mr. Talbot, for the reproduction of engravings, is, that the first gives the image immediately in its true position, whilst, on the calotype paper, the image is *reversed or negative;* that is to say, the blacks are in the place of the whites, and vice versâ; and it is only by a counterproof that a positive image is obtained.

‡ Mr. Verignon's paper is excellent for the reproduction of engravings.

mixture formed of 2 parts of hydrochlorate of ammonia, 2 parts of bromide of sodium, and 1 part of chloride of strontium. The paper, after being dried over again, is passed through a very dilute solution of nitrate of silver. There is thus formed, by a double decomposition, a chloride and a bromide of silver, which is rendered black by exposing the paper to the light during the space of half an hour. The paper thus prepared may remain sensitive during a fortnight, but, at the end of that time, the black will have penetrated through to the other side of the paper, which will have then lost its sensitiveness.

In order to obtain the photographic effect, it is only necessary to steep the paper in a very dilute solution of iodide of sodium, and to convey it immediately, wet as it is, into the camera, placing it so as to receive the luminous image. At the end of twelve minutes, if the weather be favourable, the photogenic effect is entirely produced. When once the image is obtained, nothing remains, in order to fix the picture, but to pass it in a very dilute solution of hyposulphite of soda and iron, and then to wash it in pure water: the operation is then completed.

Mr. Lassaigne had employed, in April, 1839, for the reproduction of engravings, without the help of the camera, a paper bearing a great analogy with the above.

We entertained our readers in the chapter which treats of the continuating glasses, with the interesting researches of Mr. Edmund Becquerel. Mr. Talbot

also appears to have made, at the same period, numerous investigations into the continuating properties of certain rays applied to his calotype paper.

We shall not give the description of all the sensitive papers which have been proposed, but confine ourselves to mentioning Mr. Raife, for his plated paper, and also, Messrs. Schaefhaeult, Hunt and Petzhold. We cannot, however, forbear giving the extremely simple preparation of a paper by Mr. Ponton, communicated by Mr. Edmund Becquerel.

MR. PONTON'S PAPER.

"Several months ago, Mr. Ponton made known his paper, a description of which we shall give hereafter. Its preparation consists in immersing a sheet of paper in a solution of bichromate of potassium, drying the paper, and then exposing it to the light. The action of the chromic acid on the paper is such that the parts exposed to the radiation become gradually coloured, passing successively through the dark orange, and then the dark brown colour; afterwards the paper is immersed in water, and all the bichromate which has not been exposed to the solar action is dissolved, and those parts only are imprinted on the paper which have been exposed to the light. By means of this paper, Mr. Ponton has copied engravings with success. A feeble representation of the object is thus obtained, the shades being repre-

sented by the whites, and *vice versâ*, as with the chloride and bromide of silver paper. By studying the action of chromic acid on organic substances, under the influence of light; a subject which I am at present engaged on, I have been led to continue Mr. Ponton's process: and I have succeeded in producing a new paper, so as to represent, in the picture produced by the action of the solar radiation, the shades by the shades, and the whites by the whites, and to give not only another tint to the image, but greater vigour. It is only necessary to immerse a paper prepared after Mr. Ponton's manner, and on which there exists a faint copy of an image, into an alcoholic solution of iodine, to wash this paper in water, and then to dry it: the parts which were white become blue, and those which were yellow remain more or less white.

"The explanation in detail of this process is as follows. Having employed different sorts of paper, covered with a coating of bichromate, I found that they were not all able to reproduce pictures rapidly; that the mode of sizing the paper had an influence on the coloration of the light, and that, with unsized paper, this coloration was only accomplished in the course of time. From that moment, I perceived that the principal reaction took place between the chromic acid contained in the bichromate, and the starch contained in the size of the paper. Then, as starch possesses the property of forming with iodine a combination of a very fine blue, I imagined that on

the parts of the paper which had not been exposed to the action of the solar rays, the starch not having combined with the chromic acid, the iodine would form the blue iodide, and thus represent shades by shades.

"When it is desired to copy an engraving by means of this process, the course I have followed may be imitated. First ascertain that the paper is well sized, and that the starch is spread uniformly over its surface; for that purpose, steep it in a weak alcoholic solution of iodine; then wash it copiously in water. By this second immersion, it must assume a beautiful blue tint, which the first did not impart to it. If this tint be uniform, the paper is deemed proper for the experiment; in the contrary case, the operator might size it himself with starch.

"It is afterwards steeped, in accordance with Mr. Ponton's method, in a concentrated solution of bichromate of potassium; then, in order that the paper may be coloured uniformly, press it forcibly, after immersing it a few seconds between some sheets of blotting-paper, and then dry it, either by leaving it within the folds of the blotting-paper, in the dark, or by holding it to the fire. This paper to be very sensitive, must be very dry. When it is thus coated with the bichromate, it is placed on a board, then covered with the engraving, taking care that the engraved side be placed upon the sensitive paper, and, with a sheet of plate-glass at top, press the two, one against the other, and expose them in that state

to the solar rays. After a time, which varies between thirty seconds and fifteen minutes, according to the thickness of the paper of the engraving, the copy will be sufficiently marked (with a diffused light this time would be longer). Next, take off the engraving, wash the paper and dry it; when it is dry, steep it in a weak alcoholic solution of iodine, and, when it has remained there some time, wash it in water, and dry it carefully between the folds of some blotting-paper; but not before the fire, because, a little before 100 degrees, the iodide of starch becomes discoloured. If you judge that the copy is not sufficiently brought out, repeat the immersion several times. By this means, you may obtain the intensity of tone that you wish the picture to have; which intensity you could not change at will, if you were to employ a more concentrated solution of iodine.

"When the paper is damp, the shades are a very fine blue; but when dry, the colour becomes of a dark violet. I have found that, if covered over with a coating of gum-arabic, while it is yet damp, the colour of the picture is, in great part, preserved, and is finer than when it is dry. When a paper is thus prepared, it loses a little of its tone during the first moments, but afterwards recovers and preserves its violet hue."

By means of this process, engravings and drawings may be faithfully copied, and that at a very small cost, for the preparation is not expensive, and is very easy in its application. However, the vigour of the

picture produced is not equal to that of an engraving, neither has it so rich a tone. The last tints will be faithfully produced, and this copy will come very nigh to a stump-drawing.

The attempts made to reproduce the images of the camera with this sensitive paper, have not yet given any results which are completely satisfactory.

CHAPTER XXIV.

ON THE TRANSFER OF THE PROOFS.

A GREAT many researches have been made on the possibility of transferring Daguerreian images upon the lithographic stone. Up to the present time, these inquiries have been fruitless, and the only results which have attended them, consist in a method of transferring the image depicted on the plate, by means of a press, to a sheet of black paper covered with a coating of gelatine in a moist state. It is left in the press for about half an hour, and, at the expiration of that time, dried in the sun; the paper then separates from the plate, and tracings of the Daguerreian image, more or less complete, will be seen on its surface.

CHAPTER XXV.

MISCELLANEOUS.

CONSIDERATIONS RELATIVE TO THE CHEMICAL ACTION OF LIGHT. BY MR. ARAGO.

A LETTER from Mr. Edmund Becquerel gave rise, in the Academy of Sciences, to a verbal communication from Mr. Arago, which we present to our readers nearly *verbatim.*

A short time after the law was voted granting a national recompense to Messrs. Daguerre and Neipce, some opinions, which in my idea were very erroneous, were entertained by a small portion of the public, which rendered it necessary for me to show that the discovery newly made was not to be estimated in respect to art only, but to the very valuable subjects for investigation which it presented in reference to the physical sciences. Such was the purport of a note, which appeared in the minutes of the proceedings at the Academy of Sciences, 19th August, 1839. It is in these terms:—

"The following is an application of which the Daguerreotype is susceptible, and which appears to me to be worthy of attention:—

"It has been proved by observation that the solar spectrum is not continuous; that there exist in it

transversal interruptions of continuity; lines which are entirely black. Do there exist similar interruptions of continuity in the black rays, which the photogenic effects appear to produce?

"If so, do they correspond with the black lines in the luminous spectrum?

"Since several transversal lines of the spectrum are visible to the naked eye—that is to say, when they are depicted on the retina without any amplification—the problem which I have just laid down will be easily solved."

This very easy solution of a problem which I had proposed to myself, I could not, in 1839, seek experimentally, the old camera of the Observatory having then been applied to another use, and the new one not being constructed. However, I must suppose that the subject, as proposed by me, was entertained; for I subsequently learned that the Royal Society, on the 20th February, 1840, received a communication from Sir John Herschel, in which the question is glanced at, and it will be remembered that Mr. Edmund Becquerel submitted the same subject to the Academy, in its sitting of the 13th June, 1842. Sir John Herschel not having at his disposal an helioscope, would not take upon himself to decide positively as to the existence of lines in the photographic image of the spectrum. Mr. Edmund Becquerel, on the contrary, projected on his iodized plate a stationary spectrum, and saw clearly after the experiment, in the region of the plate occupied by this spectrum, trans-

versal lines, along which the chemical substance had remained unaltered, or at least had undergone no perceptible modification. He ascertained, moreover, that these lines corresponded exactly with the dark lines of the luminous spectrum.

At first sight, the experiment I have just spoken of might seem to be superfluous, for the result obtained was the one which must necessarily have been anticipated;—how can we expect a photogenic action where light is entirely wanting?

This is my answer: it is not at all demonstrated that the photogenic modifications of the impressionable substances result from the action of the solar light itself. These modifications are perhaps engendered by invisible radiations mixed with the light properly so called, accompanying it, and in like manner refracted. In this case, experience would go to prove, not only, that the spectrum formed by these invisible rays is not continuous, but that there exist in it interruptions of continuity, as in the visible spectrum; moreover, that in the two spectrums, when superposed, these lines *correspond exactly*. This result, if true, would be one of the strangest and most curious ever known to the scientific world.

Let us introduce into the discussion an element depending for its action on the rapidity of the transmission of light, and the consequences of the previous observation will not be less interesting.

I proved, several years ago, that the rays proceeding from the stars towards which the earth is ap-

proaching, and those of the stars from which the earth is receding, have an exactly equal degree of refrangibility. Such a result cannot agree *with the theory of the radiation* of light; but, by means of an important addition to be made to that theory, the necessity of which, struck me some time ago, and which has been generally well received by those who study natural philosophy: it must be admitted that luminous bodies radiate light of every degree of velocity, and that only those of a determinate velocity are visible, that they alone produce in the eye the sensation of vision. In the theory of radiation the solar red, yellow, green, blue and violet, are respectively accompanied by rays which are similar to them; but invisible by defect, or excess of velocity, in transmission. To a greater degree of velocity belongs a lesser refraction, as to a lesser velocity, a greater refraction. Thus each visible red ray is accompanied by invisible rays of the same nature, which are refracted some more, some less, than itself: it is therefore positive, that there *exist rays in the black lines* of the red portion of the spectrum; the same must be said of the lines situated in the yellow, green, blue, and violet portions of it. Experience having shown that the rays contained in the dark lines, are without effect upon the impressionable substances, it is satisfactorily proved that all increase or diminution of velocity, in their passage, deprives the luminous rays of the photogenic properties with which they were primarily endowed; that the solar

rays cease to act chemically from the instant that they lose, by a change of velocity, the faculty of producing on the retina the luminous sensations. I need not dwell upon the singularity of a chemical mode of action of light, which depends upon the velocity of its rays.

The same day on which Mr. Edmund Becquerel presented to the Academy, the result of the experiment which I had proposed two years and ten months previously, I invited him publicly to renew it, under other conditions which seemed likely to throw a light upon the manner in which the velocity modifies the chemical action of light. I showed that the solar rays, moving faster and faster as they traversed a medium which is more or less refrangent, some useful result would be obtained by studying, comparatively and simultaneously, the action of the spectrum upon the iodized plate, immersed by halves in two very dissimilar media; in water and air, for example. Mr. Edmund Becquerel was kind enough to follow out this idea. The following is the letter which he wrote to me on the subject, dated 25th November, 1842.

"When you had the kindness to present to the Academy of Sciences, in the month of June last, my memoir on the constitution of the solar spectrum, you were good enough to suggest to me an experiment which was yet to be made, in order to ascertain if when a substance, impressionable by the action of the solar rays, is immersed in a medium different

to the air; the change of velocity of the solar rays, at their passage through this medium, would not alter the position of the lines, or transversal striæ of the spectrum of the chemical rays.

"I immediately applied myself to making these experiments, and began by using water as a new medium. My departure for the country forced me to interrupt them. I had intended to continue them, on my return, before making known the result; but the bad state of the season has not allowed me to realise my project. However, I have the honour to address to you the result of a double experiment, which I have made, as well as the description of the process which I followed.

"I made use of a small crystal vessel, with flat sides, and, of a plate prepared after Mr. Daguerre's manner, placed vertically in the vessel, in such manner that its surface was parallel to the front of the vessel. In the experiment, the distance between the iodized plate and the front of the vessel was one centimètre. I then introduced into the camera a bundle of solar rays, through a narrow crevice made in the shutter; these rays were refracted through a very pure flint prism, in front of which was placed a lens with long focus, so as to obtain, by projection, a solar spectrum with all its striæ. When this result was obtained, I placed the vessel in the direction of the refracted ray, so that the spectrum imprinted itself horizontally with all its striæ on the iodised plate, and so that the violet rays entered

normally at the front of the vessel. Before commencing the experiment, water was poured into the crystal vessel, until its level cut the image of the spectrum longitudinally into two equal parts.

"After the action had lasted one or two minutes, the plate was withdrawn and exposed to the mercurial vapours, the image of the spectrum was seen on it from the limit of the green and blue to much beyond the extreme violet; and, as I stated in the Memoir, this image had all its striæ similar to those of the luminous spectrum, for those portions possessing the same refrangibility. No very sensible difference can be perceived between the image of the spectrum on that part of the plate which remained in the air and that immersed in the water: the striæ of these two portions of the spectrum seem to be a very exact prolongation one of the other, except, however, in the extreme portions of the chemical spectrum, on the right and on the left, where the striæ of the image produced in the water seem to narrow a little among themselves. It appears to me that this must be attributed to the refraction of the oblique rays.

"This experiment tends to show that the nature of the medium in which is immersed the substance, chemically impressionable under the action of the solar rays, does not modify their action, so that the impression of the solar spectrum upon that substance always produces the same lines, and at the same places.

"When the weather will permit, I intend to resume these experiments, to vary them, and I may, perhaps, succeed in obtaining more conclusive results.

"I have the honour to be, &c."*

We thus see that the solar rays produce the same effect in the air as in water. In the air, however, according to the theory of radiation, the light progresses much slower than in water. The degree of velocity in this case has therefore no influence, a consequence which, at first sight, seems in manifest contradiction with the inferences which we have deduced from the first experiment. The two results, however, are not irreconcileable. It appears to me that a new hypothesis may make them agree; of this, however, every one will be able to judge.

The velocity with which a luminous ray traverses any given body, depends exclusively on the refrangibility of this body, on *the quickness of radiation of the ray*, and of the velocity which it had in vacuo. The ray which arrives at the surface of the coating of iodine, through the water, possesses, at the point where it meets the surface, a velocity superior to that which the ray moving through the air had at the same point; but, *in the interior of the coating itself*, at a sufficient depth, the two rays have exactly the same velocity. Let us only assume that the photogenic phenomena depend, not upon an action exercised at the surface, but on one which takes place in the interior of the coating, and all difficulty disappears: only, singular enough, we are thereby

compelled to establish an essential distinction between the interior and the surface of a coating of inconceivable thinness.

In thus considering the photogenic phenomena as examples of molecular action, susceptible of precise calculation, every one will understand how interesting it would be to introduce figures into the general reasonings which I have just presented. This end will be attained by completing, in the first place, the experiments, by means of which Mr. Dumas had begun to determine the thickness of the coating of iodine, upon which the Daguerreian images are formed, from the comparative weighings of a large silvered plate before and after its iodization. The greatest degree of exactness which is possible must then be used in the observation of the relative positions of the dark striæ on the impressionable matter, even by having recourse to the assistance of the microscope, if necessary; in fine, instead of passing, by a sudden transition, from air to water, it will be well to compare the relative positions of the striæ produced in two media, slightly different in density or in refrangibility. Even as the case now stands, *in accordance with the theory of radiation*, the following propositions are rigorously deduced from the discussion which I have just gone into.

If the photogenic effects of the solar light result exclusively from the action of invisible rays, mixed with the visible rays, progressing with them, and with velocities of the same order, the superposed

spectra of these two species of rays have their interruptions of continuity exactly at the same points.

If the visible rays produce the photogenic effects wholly or in part, this property must depend exclusively on their velocity, and they lose it equally when this velocity increases as when it diminishes.

The photogenic effects of the solar light, whether they are caused by visible or invisible rays, cannot be attributed to an action exercised at the surface of the impressionable coating; it is in the interior of the impressionable matter that the centre of this kind of action must be sought.

The foregoing conclusions may be further extended when it shall be known what is the thickness of the thinnest coating of iodine in which are produced the Daguerreian phenomena; when it shall be possible to compare that with the length of the *accesses*, or that of the luminous undulations.

Recorded facts serve as much to the advancement of the sciences as theories; we must not, therefore, be much surprised at seeing collected, with so much care, a multiplicity of experiments, which at first sight appear only curious; but the whole of which, taken together, may in reality serve to establish theories, and consequently to give the explanation of a great number of isolated facts.

It will have been observed, that the explanation of

what takes place in the formation of the Daguerreian images is not entirely satisfactory to the mind; it is therefore, not impossible that the adjunction of certain facts, which seem to have a more or less direct bearing on these phenomena, may contribute to negative, rectify or confirm the existing theory. It will be already surmised that we allude to the experiments of Mr. Moser, and to those which have reference to them. These experiments are of the most curious character, and perhaps even derive their singularity from their very mysterious nature; and we have no doubt that a great number of amateurs will apply themselves to repeat them; and as, in all these experiments, a slight modification in the manner of operating may bring about a totally different result, we earnestly recommend experimentalists to keep an exact journal of their observations, as the multiplication of facts can alone lead to the explanation of such remarkable phenomena. Whether these phenomena are produced by the action of the luminous radiation of bodies in the deepest darkness; whether they are the result of an evaporation of organic matter carried off by the vapour of water; or lastly, whether they are only produced by thermographic or electographic actions, is what we will not allow ourselves to discuss; our province is here merely that of the historian: we shall, therefore, confine ourselves to relating, in chronological order, the experiments which have been made.

ON THE FORMATION OF THE DAGUERREIAN IMAGES.

"It is now known that when an iodized plate is left, during a proper time, in the camera, a visible image is immediately obtained, without the necessity of exposing the plate to the mercury. But this image is an inverse or negative image; that is to say, the white parts are black, and the shades white. In Mr. Daguerre's discovery, the operator does not wait till this negative image appears; when he withdraws the plate from the action of light, nothing is perceptible on it; but the iodized coating is sufficiently affected to cause the image to appear, as soon as the plate has been exposed to the mercurial vapours. To obtain that result, it is, however, necessary that the plate should have remained exposed during a sufficient time to the light.

"The curious experiments made by Mr. Edmund Becquerel, have shown that an extremely short time was sufficient to give to the iodized pellicle, a rather strong impression, which was not rendered immediately visible, it is true, by the vapour of mercury; but that, if the plate were afterwards placed, during a certain time, in the sun, under a red glass, the thin film of iodine would continue to be impressioned, and the image would, after this new action, become visible by means of the mercurial vapour. Thence the distinction established by Mr. Becquerel, *of exciting rays, and continuating rays.*

"Mr. Moser has set forth the principal results

obtained by Mr. Becquerel, and has observed new facts.

"He has found that it is necessary that the iodized plate should remain exposed, during a particular time, under the influence of the first rays in the camera, in order that he image might be afterwards developed under the red glass; but that, if the action under the latter were prolonged for a considerable time, a *negative image* would appear as the result—(without the use of mercury).

"Mr. Gaudin had already found, that the yellow glasses are, in this case, much more active than the red ones, and Mr. Moser has observed the following curious fact:—An iodized plate, which had remained in the camera, nearly the proper time for giving the ordinary *positive image*, by the action of the mercurial vapour, was placed under a yellow glass; it then showed no image; but, as soon as it was exposed to the sun's rays, under the yellow glass, a *negative image* was very rapidly formed; it then disappeared at the end of a few seconds, and, after the lapse of ten or fifteen minutes, a *positive image* appeared in place of the *negative one*.

"Mr. Moser has never been able to obtain a positive image when using the red glasses, whatever might be the time of exposition; but he has found that this transformation was very well performed under the green glass.

"Mr. Moser has been led to distinguish, in the following manner, the action of the various rays of

the spectrum on the unimpressioned iodized coating, the violet and blue rays are the only active ones; they produce a commencement of alteration, which is not visible though it does exist; but which becomes apparent by the action of the mercurial vapour, when this alteration has arrived at a certain point. But we may distinguish two periods in this progressive alteration of the idiozed coating: at the end of the first period, it is modified to such a degree that the red and orange coloured rays then act as well as the blue and violet ones; but the yellow rays do not as yet act; for, if you withdraw the plate too soon from the camera, the yellow rays will be found to have been quite inactive. At the end of the second period, the green and yellow rays act in their turn; the plate is then very near the point at which the image can become visible under the influence of the mercurial vapours.

"An iodized plate was placed in the camera and left during the space of one hour, directed towards some objects illumined by the sun's rays, so as to obtain a very distinct *negative image*; this image was then placed in the sunshine; at the end of a few minutes, the negative image had disappeared, and instead of it was seen a *positive image*, quite as distinct, in which the white parts had a greenish tint, and the shades a dark brown red colour. Mr. Moser ascribes this last effect to the yellow and green rays.

"These experiments of Mr. Moser show, that two

images are formed successively, and in a direct manner, upon the plate. Mr. Moser has endeavoured to discover whether other modifications of the image do not take place at other stages of the process; for that purpose, he took two plates, of which one had been subjected to the iodine, and the other to the chloride of iodine, and placed each of them in a separate camera, the lenses of which were turned towards some distant houses: the cameras were in a room completely darkened, to avoid the action of the diffused light. The season was very favourable; it was in winter: the experiment was prolonged during thirteen days, at the end of which period, positive images were found on the two plates. The one which had been subjected to the chloride of iodine presented the strongest image, and had a very fine appearance by the brightness of its colours; the light parts were of a very bright sky-blue, and the shades of a very intense fire-red. Mr. Moser considers these images as being always the first positive image.

"The plate prepared by the chloride of iodine having been immersed in the solution of hyposulphite of soda, the colours immediately disappeared, and the negative *image was preserved.*

"Mr. Moser afterwards made a series of experiments with polarised rays, in order to discover whether the rays which produced the images differed in this respect from the luminous rays; he has not been able to ascertain any difference between them.

"He placed in front of the lens of the camera an

achromatic prism, composed of carbonate of lime, for one of the images, and directed the lens upon a statue: the result was, that he obtained two images that were perfectly distinct and clear, although only one of the two appeared achromatic to the eye of the beholder.

"Mr. Moser also obtained impressions of the coloured rings, and of the images given by the polarised light in crystallised plates, coloured glasses, &c., &c.; in all these cases the images were found to be similar to those that are seen direct by the naked eye.

"It has long been known that if a piece of plate-glass, well polished, be written upon with certain substances, and afterwards the writing be effaced, and the surface completely cleaned, the letters always reappear when the glass is breathed upon. Mr. Moser has proved that this phenomenon is the case with all polished bodies, whatever be the nature of the substance with which the writing may have been traced. It is thus that this effect is obtained, in a very evident manner, in breathing upon a looking-glass, and tracing immediately upon it some letters with a very clean hair pencil: if you breathe again upon the glass, after the first moisture has evaporated, the writing will reappear. The same phenomenon is exhibited even after an interval of several days on the surface of mercury, provided that liquid is left in a state of perfect rest. It is also observed, by placing upon a polished plate a pattern

cut out, and then breathing upon the pattern. The vapour of water, which becomes condensed at the parts cut out, being evaporated, you can always discover, on breathing afresh upon the plate, the place occupied by the parts of the pattern cut out on the first application of the breath.

" Mr. Regnault thinks, that in these last experiments, the small quantity of greasy matter which is constantly found on the surface of bodies, or which may have been cast upon them by the breath, may have a considerable share in the production of the phenomenon in question; by being deposited in different quantities on the surface of the plate, it may sufficiently modify the nature of that surface, so as to cause such modification to be evidenced by the unequal reflections of light produced on the unequal deposite of the vapour.

" Mr. Moser has found that the vapour of iodine and the vapour of mercury are very excellent agents to produce the manifestation of images; in cases where the vapour of iodine alone did not bring out the image, it was generally produced afterwards, by exposing the plate to the mercurial vapours.

" A silver plate was iodized in the same manner as for the Daguerreian proofs: on it were placed various objects, metallic and non-metallic medals. Sometimes, on an object being taken off the place it had occupied, the impression was immediately recognised; but it was chiefly by exposing the plate to the vapour of mercury that the image appeared in a sufficiently

distinct manner to appreciate perfectly the figures, letters, &c.

"This experiment succeeds just as well in complete darkness, or during the night, as under the influence of light.

"An iodized plate acted upon in the same manner, presented no image after the object had been taken off; but the image appeared immediately with the greatest distinctness, when the plate was exposed to the diffused light, or to the sun.

A visible image may even be obtained on a very highly polished silver plate, which has never been used, *without subjecting it previously to the iodine;* after being in contact with the object, it is exposed to the vapour of mercury. The same experiment has succeeded with other metallic plates.

"Mr. Moser concludes from these experiments, that, when a surface has been touched in certain parts by a body, the former has acquired the property of condensing the vapours of the substances, which exercise a certain force of adhesion towards it, acting in a different manner on the parts touched, than on those which have not been in contact with it. So that it would appear that the contact would have produced in this case a modification analogous to that of the action of light.

"Among the experiments made by Mr. Moser, I will cite the following:—a silver plate having been iodized during the night, and in complete darkness,—an engraved agate medal, a horn ring, &c., were

placed upon the plate, which was afterwards subjected to the mercurial vapour, when perfectly distinct images of the figures engraved on the agate, letters engraved on the metallic plate, and the ring, &c., were seen on the iodi 'ed silver plate.

"Plates acted upon in the same manner, were exposed to the diffused and solar light, and images quite as distinct were seen to appear directly upon them. Other experiments were made, in which the impressioned plate was exposed under coloured glasses, to the solar radiations; only tracings of the images were obtained under the red and yellow glasses, whilst under the violet glasses, the images were very distinct.

"A silver plate, which had never been used, was polished with great care, and then placed under a black screen, in which figures had been cut out; the screen did not touch the plate. The apparatus was exposed during several successive days to the solar light. The plate having been afterwards subjected to the mercurial vapours, the image of the parts cut out, appeared perfectly distinct on the plate.

"The same experiment succeeded very well with a copper-plate, by exposing it afterwards to the vapour of iodine.

"The same result was obtained upon a piece of looking-glass, by breathing upon it after the contact.

"The foregoing experiments demonstrate that modifications analogous to those which these bodies experience under the influence of light, are formed on

the surface of polished bodies by contact. But here follows a much more extraordinary result, mentioned by Mr. Moser: it is, that the same phenomenon is produced in the most complete darkness, by bodies placed at a distance. Mr. Moser announces this fact in the following manner:—*When two bodies are sufficiently near each other, they imprint their images respectively one on the other.*

"The experiments, illustrative of the above fact, were made in total darkness, and by night; the plates, and the bodies producing the image, were put into a closed box, which was placed in a perfectly dark room. The images sometimes appeared after the action had lasted ten minutes.

"Mr. Moser has endeavoured to find out, whether phosphorescence was in any way the cause of this phenomenon; but he has not been able to detect any difference between the action of a body left, during several days, in complete darkness, and that which had just been exposed to the action of the solar rays. This result was very satisfactory in an experiment with an agate plate. which was exposed in the sun, having half of its surface protected from the solar rays. It was impossible to distinguish any difference in the image obtained by means of this agate, on a polished silver plate between the part exposed, and that which had remained covered.

"The mercurial vapours are not essential to render manifest these phenomena: thus, an iodized silver plate being subjected in complete darkness to the

action of a body placed over it at a small distance, during a sufficient time the image appears; and the parts which have been most acted upon, are blackened considerably.

"The only manner of explaining the formation of distinct images in these cases, if it be attributed to radiations, is evidently to admit, that these radiations diminish very rapidly in intensity, in the ratio of their obliquity, and this is what Mr. Moser himself admits.

M. de Humboldt announces in his letter, that Mr. Moser's experiments on the formation of images in darkness, by means of contact and the placing at small distances, have been repeated with full success at Berlin, by Mr. Aschersohn in his presence, and in that of Mr. Encke the Astronomer.

"An ornamental engraved plate was placed upon a highly polished silver plate which had not been iodized, and left during the space of twenty minutes: the image was but indistinctly represented on the plate, but became more perfect by iodizing the plate, and afterwards subjecting it to the mercury. In another experiment a cornelian cameo, bearing an inscription, was placed over the polished silver plate, and the letters were perfectly legible thereon.

"Mr. Aschersohn has obtained very distinct traces of images, by placing the engraved metal plate at the distance of about one third of a line from the silver plates."

Mr. Moser thus resumes his researches on the subject :—

"1. Light acts upon all bodies, and upon all in the same manner; the various actions of light hitherto known, are only particular illustrations of this general fact.

"2. The action of light exhibits itself in modifying bodies in such a manner, that, after having experienced this action, they condense the various vapours, otherwise than they would do without it. Mr. Daguerre's discovery rests upon that proposition, and presents one illustration of that general action.

"3. The vapours are condensed more or less by the substances thus modified, according to their elasticity, and to the intensity of the luminous action.

"4. It is known that the iodide of silver begins by blackening under the influence of light.

"5. If the action of the light be prolonged, the iodide becomes transformed into coloured iodide.

"6. The differently refrangible rays have one simple and identical action, and there exists no difference between them; but in the time which they take to produce a determined effect.

"7. The blue and violet rays, and the dark rays, discovered by Ritter, commence rapidly the action upon the iodide of silver; the other rays, to produce the same effect, require a longer time in proportion to their refrangibility.

"8. However, the action (5.) is more rapidly begun, and effected by the red and yellow rays; the other rays employ so much the more time in

proportion as they have a greater degree of refrangibility.

"9. All bodies radiate light, even in complete darkness.

"10. This light does not appear to be allied to phosphorescence, for there is no difference perceived, whether the bodies have been long in the dark, or whether they have just been exposed to day-light or even to direct solar light.

"11. The rays emanating from different bodies, act as light does upon all substances, and produce the effects pointed out (2 and 4).

"12. These rays, which have no action on the retina, have a greater degree of refrangibility than those which proceed from the solar light, whether direct or diffused.

"13. Two bodies constantly imprint their images one upon the other, even when they are placed in complete darkness (1, 9 and 11).

"14. However, in order that the image may be discernible, the distances of the bodies from each other must not be very considerable on account of the divergence of the rays.

"15. To render such an image visible, any vapour may be used, as, for example, the vapour of water, mercury, iodine, chlorine, bromine, or chloride of iodine, &c. &c.

"16. As the rays which bodies give out thus spontaneously, have a greater degree of refrangibility than belongs to those hitherto known; it is in

like manner also, these rays which generally commence the actions upon the other substances with the most intensity (7).

"17. There exists latent light as well as latent heat.

"18. When a liquid becomes vaporised, the light which corresponds with a certain duration of oscillation becomes latent, and is again liberated when the vapour condenses in liquid drops.

"19. It is for that reason that the condensation of the vapours produces in some degree the same effects as light; it is thus that the part performed by the vapour is explained (2 and 15).

"20. The condensation of the vapours on the plates acts the same as light, whether the vapour in excess adheres simply, as does the vapour of water on the greater number of substances, or in a permanent manner, as does habitually mercury, or whether it combines chemically with the substance, as for example, the vapour of iodine with silver.

"21. The latent light of the vapour of mercury is yellow; all the actions which the yellow rays produce may be obtained by the condensation of the vapour of mercury.

"22. The latent colour of the vapour of iodine is blue or violet; the actions of the blue or violet rays may be equally reproduced by the condensation of the vapour of iodine.

"23. The latent colours of chlorine, bromine, chloride of iodine and of the bromide of iodine, appear

to differ but little, as to their refrangibility, from that of the iodine.

"24. As to the latent colour of the vapour of water, I can only say that it is neither green, yellow, orange nor red.

"25. The iodide of silver owes its sensitiveness for the visible rays to the latent light of the vapour of iodine.

"26. The iodide of silver is not more sensible to the invisible rays than is silver itself."

Letter from Mr. Bréguet to Mr. Arago, confirming the Experiments of Mr. Moser.

"The remarkable facts which have just been discovered by Professor Moser, the communication of which was lately made to the Academy, by Mr. Regnault, remind me of something analogous which we have observed from time to time on the inside of gold watch-cases, and even in the interior of machines of which all the pieces were made of brass.

"Every one knows that most watches contain an inner case, on which is engraved the name of the maker. This inner case is in juxtaposition with the first; there exist between them a space not exceeding one-tenth of a millimètre at most. We have often seen on the inside of the outer case a reversed and very distinct image of the name engraved on the inner one.

"In some machines wherein pieces were also placed at very small distances apart, we have also seen the representation of figures of a more or less remarkable character.

"We had considered these facts as very curious, and had even made them known to some of our friends; but not having had time to investigate this strange phenomenon, we forbore, hitherto, noticing it publicly.

"But now that these phenomena belong to the domain of science, it will not be thought out of place that we should present these facts, without accompanying them with any observations; for the more facts are multiplied, the sooner we shall obtain an explanation of so remarkable a phenomenon."

On the Images formed on the surface of a looking-glass, or any other polished body, produced by an object placed very near that surface, but without actual contact; by Mr. Moser.

"I am now able to give you some information and explanation relative to that singular image of which your letter treats, and that the celebrated sculptor, Mr. Rauch, saw produced on the interior of a looking-glass placed, during a great number of years, before an engraving from one of Raphael's pictures, but without being in contact with that engraving. I remember, myself, to have seen a similar image on

porcelain, though I did not then pay much attention to the circumstance; a series of experiments and observations carried out with attention, have enabled me to study the phenomenon, which is so well known to those persons whose business it is to frame and glaze engravings, that all of them at Konigsberg speak of it as of a very common occurrence. I soon found, from my first attempts, that, fortunately, it does not require a very long period of time to produce these images; I obtained some on a looking-glass at the end of two days, by the invisible rays; I had employed no vapour. The glass had a whiter tint on that part of it which was acted upon by the invisible rays; the image was of a certain distinctness but easy to rub off. In this first experiment there was contact; the next step was to operate with an intervening distance; *an engraved plate* remained nine days at a distance of two or three tenths of a line from the glass; this is more conclusive. The image of the engraved part of the plate was as distinct on the glass as when in immediate contact with it.

"I have obtained these same images on copper, brass, zinc, and even on gold, in five days; they are of great delicacy of detail, but easily destroyed by the touch. Having already established that there does not exist any effect produced by a certain kind of rays, which may not be also obtained by rays of another refrangibility, I was necessarily led to foresee that the phenomena would be the same, if I employed the visible rays at a proper degree of

intensity. I easily succeeded in obtaining these images, which I call *Rauch's images*, by means of the solar light upon copper, zinc, silver, and brass. Occupied as I am at present in making other experiments, which interest me peculiarly, I have not been able to study the phenomenon in rarefied air; it is moreover a common thing to find some of Rauch's images in the interior of our watches. If we take off the outer case, we shall find represented on it, especially on the brass caps, different parts of the interior of the watch. These images are also of a whitish cast, and are effaced by friction; they become more intense by breathing on, or iodizing them. I hope soon to be able to communicate to you some curious results on the transmission of invisible rays through certain substances."

On the Images produced on the surface of a polished Metal, by the proximity of another body, by Mr. Moser.

"I hasten to acquaint you with my new researches on the formation of the images produced by the action of the invisible rays. When these rays have produced their effect, the image can only be made apparent by breathing on the plate, or by exposing it to a vapour of a more elevated tension. If the invisible rays have acted for a long time (as is the case with the engravings placed opposite, but without contact to

a looking-glass), the humidity of the atmosphere suffices to bring out the impression. This humidity becomes condensed on the parts which have experienced the action of the rays; the vapours adhere to those parts. The image has the same appearance as when the mercurial vapours adhere to a plate subjected to the Daguerreian process. This explanation, on the satisfactory nature of which no doubt remains on my mind, has led me to adopt the following inferences. I have already proved that rays of every degree of refrangibility, produce the same effects; but they require a certain length of time. If, then, the invisible rays condense the vapours contained in the air, the visible rays must produce the same effect if they are made to act during a sufficient time, and with a great degree of intensity. A plate may remain for a considerable time exposed to the sun's rays, and though elevated to a high temperature, it will become covered with dew. Last year I exposed in the sun, during several hours, some metal plates and pieces of glass covered with paper screens, in which I had cut out certain parts, and I obtained some very distinct images representing the pattern, or the parts of the screen cut out. These images were entirely similar to those you have sent me, and which had been formed in the course of a number of years near and opposite an engraving. In my experiment, the vapour of the atmosphere had been precipitated on the plates, though these latter were not in the least below the temperature of the air, which is a condition required

for the formation of ordinary dew. I am obliged to admit that there are two bodies which emanate from the sun—light and heat. In respect to the actions performed in the composition of dew, these two forces possess properties which are diametrically opposite. Our theory of the formation of dew was not, therefore, complete; we did not know the action which light performed in that phenomenon. To show how heat may favour the formation of images and the adhesion of humidity, I will remind you, that in my experiments the elevation of temperature in a brass plate, engraved with a graver, favours the production of images. The vapour condenses itself very rapidly on the polished plate, which is in contact with the engraved plate, though the latter be strongly heated. In the production of these images, immediate contact is not at all necessary; the two plates—the one which gives and the one which receives—are separated by the interposition of slips of mica. The heat will still favour the production of the images, but the action will be slower and weaker. When you heat too much after the image has been formed, the condensed vapour is again dissipated. I was very much pleased to learn that you had been kind enough to communicate my last letter to the Academy of Sciences. In accordance with your advice, I have sent to the Academy of Berlin some images produced by invisible rays, and I have at the same time submitted my doubts on the identity of light and heat. I am still occupied with experiments on latent light; it is a very difficult study, and requires much repose and patient perseverance."

On the Causes which co-operate in the production of Moser's Images, by Mr. Fizeau.

" . . . . . . Since my return, I have been actively engaged in examining the singular phenomena observed by Mr. Moser, and I hope, in a short time, to have the honour to present to the Academy some remarks on this subject. I shall, therefore, at present, confine myself to speak of the general results which I have obtained.

"Most of the experiments I have hitherto made, have confirmed the facts announced; but I must say, that all of them have led me to consider the subject in quite a different light from Mr. Moser.

"Far from thinking that we must admit new radiations emanating from all bodies, even in complete darkness, and subject in their radiation to special laws, I am convinced that no species of radiation need be invoked in the explanation of these phenomena; but that they must rather be attributed to the known facts which I am going to mention.

"1st. Most of the bodies on which we operate, have their surface covered with a slight film, or coating of organic matter, bearing some analogy to greasy substances, and moreover, volatile, or at least, susceptible of being carried off by the vapour of water.

"2nd. When you condense a vapour on a polished surface, if the different parts of this surface are unequally soiled by foreign substances, even in

extremely small quantities, the condensation takes place in a manner which is visibly different on the various parts of that surface.

"When, therefore, you place a polished and pure surface in contact with any body having an unequal surface, or at a small distance from it, a part of the volatile-organic matter, with which this last surface is covered, will be condensed on the polished surface, in presence of which it is placed; and as I have supposed that the surface of the opposite body was covered with inequalities, or raised and sunken parts, that is to say, that the different parts of its surface were unequally distant from the polished surface, a transfer of unequal quantities of organic matter on the different parts of this surface, will be the result: the polished surface will have received more of this organic-matter at the points which correspond with the projections of the opposite surface; it will have received less at those points corresponding with the sunken or hollow parts; the result will therefore be a sort of image, but which is generally invisible. If you then cause a vapour to be condensed upon this polished surface, it will be affected in the manner I have pointed out above, that is to say, the condensation takes place in a manner *visibly* different at the different points: in a word, the *invisible* image becomes *visible*.

These are, in brief, the notions which I have gained from my experiments on the subject of the newly discovered phenomena, observed by Mr. Moser.

Doubtless, under this aspect, their study is less interesting than the phenomenon discovered by the Konigsberg philosopher, yet the singular action, which appears to belong to this organic matter we have spoken of, and which is found at the surface of almost all bodies, allows us to hope that we shall obtain some further elucidations on its nature and properties, hitherto so little known."

ON THE FORMATION OF MOSER'S IMAGES

(*Extract of a letter from Mr. Knorr, communicated by Mr. Bréguet to the Academy of Sciences.*)

"I devoted four weeks in studying and pursuing the discoveries lately made on invisible light by Mr. Moser of Konigsberg, and have written a short report on the subject, which I read at a meeting of our learned society, on the 7th (19th) November, 1842. On that occasion, I only entered into the relation of new facts which I had discovered, unaccompanied by theoretic speculations ; but I believe that those facts will sufficiently prove that all the actions which Mr. Moser attributes to invisible light, owe their origin to heat. In accordance with this, I have created an entirely new art, which I have named *thermography ;* for I have found that *visible* images can be obtained without any condensation of vapour on the plates, and simply by the action of heat. There are three different methods

for accomplishing this: by the first, images may be obtained in eight seconds, and up to sixteen seconds; but the operation is not always successful. The second appears to me to be only applicable with bodies which are not very good conductors of heat. The third is to be preferred, because, by it you succeed better, and almost invariably; but eight or ten minutes are required to produce an image. I have made experiments upon platina, gold, and silver coin, on engraved copper and brass plates, engraved stones, steel and glass plates, and even on copper-plate engravings; and I obtained images on copper plates plated with silver, or with pure copper upon steel and brass."

At the same period, (the 13th February, 1843,) Mr. Fizeau reminded Mr. Arago, that in consequence of his first communication (see page 185), he then already considered these new facts, (that is to say, the formation of those images which are seen on a polished surface, when objects are placed very near that surface), in opposition to Mr. Moser's opinion, as being foreign to every kind of radiation, and that he attributed them to the well known fact, that there exist greasy and volatile particles which cover the surface of most bodies.

Mr. Karsten's Experiments relative to the Formation of Moser's Images.

"Mr. Karsten (the son of the mineralogist of that name) has found, that when a medal is laid upon a glass-plate, beneath which a metal-plate has been placed, and the spark of an electrical machine is made to fall upon the medal, an image is produced on the upper surface of the glass.* If the medal rests on several plates of glass, the last being in contact with a metal-plate, the electric spark causes images to appear on all the plates, but only on their upper surfaces. The weakest images are those produced on the plates which are the farthest from the medal. These images are only rendered visible by being exposed to the vapour of iodine, or to that of mercury. The electrical spark is indispensable. Mr. Karsten has not succeeded with the electricity of the battery.

"I have witnessed Mr. Karsten's experiments. The effect is instantaneous, and the images obtained are of the greatest purity. . . . The electricity emanating from the projecting or convex parts of the medal, with greater intensity than from the others, changes the molecular state of the plates of glass as it penetrates lower into its substance. The image becomes visible by slightly breathing on it. The aqueous vapour is deposited in infinitely small drops

* We have repeated several times the experiments hereafter described. It is a sort of yellow glass which gave us the quickest and most satisfactory results.

upon all the parts, the molecular state of which has changed; whilst it is spread uniformly over those parts of the surface of the plate at which the electricity has not sensibly affected it. The image only becomes really visible by the presence of the minute drops above-mentioned.*

Mr. Poggendorff having become acquainted with Mr. Moser's experiments, applied himself immediately to repeat and vary them. From the results he obtained, he thinks that heat alone is the agent in the production of these phenomena, and that Mr. Moser is wrong in attributing them to the action of the obscure rays. Thence he insists that the new art should take the name of Thermography.

The following are some of the most curious experiments made by Mr. Knorr. Unfortunately, though simple enough, they are not even, in his opinion, sufficiently constant in their results to enable him to establish upon them scientific laws.

Over the flame of a Berzelius lamp he laid a sheet of copper twenty inches square; upon that the plates which were to receive the impressions, and

* Mr. Masson obtained, some time ago, some very curious impressions by means of a process which bears an analogy to the one above-cited, though differing in certain points. He places a medal upon a cake of resin, and then causes an electrical spark to pass through the former: the image is thus formed on the cake of resin; and to make it appear, nothing remains but to blow upon it a mixture of minium and sulphur, which is done by means of a little pair of bellows, well known to chemists. The minium adheres to certain determinate points of the cake, and imprints on it the projecting parts of the model.—*Note of the Editor.*

upon the latter* the object to be copied. The whole was then slowly heated to the degree at which a well-polished copper-plate begins to change colour, when the lamp was extinguished and the plates and model withdrawn.

At a constant temperature of 0 centigrade both for the plates and objects to be copied, the action was scarcely perceptible, though the contact was prolonged in successive operations, during intervals varying from 2 to 9 hours.

By Mr. Moser's process the same engraved plate brought into contact with a highly polished copper plate, and afterwards exposed to between 20 and 25 degrees of cold, during 10 and 12 hours, gave an image of remarkable distinctness and vigour.

Having lowered the temperature of the same objects, by exposing them in the cold during 2 hours, and having then placed them in contact, the circumstances and exposition being the same as above, no result was obtained.

Mr. Knorr, it is seen, has obtained visible images without any condensation of vapour, and by the sole action of heat.

He also made the following experiment:

Having polished a copper plate with some nitrate of mercury, he deprived it of all excess of the latter by copiously washing it in pure water. Then when it was dry, he rubbed it with a piece of soft leather,

* They were between one-sixth and one-half of a line in thickness.

and a few drops of mercury, so as to give it the appearance of a looking-glass.

He then placed an engraving very gently on the plate thus prepared, and having put upon it several sheets of paper, he obtained a perfect contact by pressing the whole with a thick plate of glass, and left it for the space of between 1 and 2 hours; * then subjected the plate to the vapours of mercury very gently heated; at the end of a few seconds the image began to appear: the mercurial vapours whitened all that corresponded with the white parts of the engraving, of which he obtained an identical representation, though rather faint. The same plate being exposed during a few instants over an iodine-box, the vapour adhered to the parts that had not been modified by the mercury and blackened them.

The impressions resulting from the vapours of mercury and iodine, resemble in a great degree the Daguerreian images, and are equally liable to be effaced.

* This duration may be much diminished by heating the plate very slightly.

END OF THE FOURTH PART.

Communication received from Mr. N. P. Lerebours, addressed to Mr. J. Egerton, Sept. 3, 1843.

"THE Academy of Sciences has recently received some communications relative to photography.—Messrs. Choiselet and St. Ratel, and Messrs. Belfield, Lefevre, and Foucault, have recently called the attention of the learned, and of experimentalists in that branch of science, to some new processes, which would tend to modify the ideas hitherto entertained relative to certain photographical operations.

"We shall begin by giving a brief notice of the modifications proposed by Messrs. Choiselet and St. Ratel, as set forth in their note on the subject submitted to the Academy.

"Having gone through a series of experiments which we need not at present describe, these gentlemen have been induced, in consequence of the observations they made on them, to consider in a new light the chemical reactions which take place in the course of the Daguerreian operations, and, after having carefully examined the action of the accelerating agents, they have obtained some novel results, and have arrived at certain conclusions, which we shall recapitulate in a few words.

"It is well known that the coating of iodide of

silver, formed on the surface of a Daguerreian plate, which has been subjected to the action of the iodine, is reduced in volume under the influence of light, so as to give rise to the formation of a sub-iodide on the parts upon which the light has acted. The formation of this sub-iodide cannot take place without setting free a certain quantity of iodine, which tends, on the one hand, to combine with the iodide thus reduced in volume, and, on the other, to attack the silver of the plate. It is, therefore, only at the end of a certain time, which may be longer or shorter, that this iodine becomes entirely absorbed by the plate, and that the latter may be withdrawn from the camera, without fearing that the action of the free iodine should destroy the effect produced by the light.

"Messrs. Choiselet and St. Ratel are of opinion, that the only means of accelerating the formation of the Daguerreian image, is to abridge the time during which the absorption of the free iodine takes place.

"Adopting this theory, it is easy to form an idea of the accelerating action of the bromine, of the chloride of iodine, and of the bromide of iodine. These substances, *which have a very great affinity for iodine*, unite intimately with the iodide which covers the plate, and absorb the iodine as fast as it is liberated: only there is reason to apprehend that the combination thus formed may be decomposed when coming in contact with the silver plate,

by giving rise to compounds which impede the action of light, and alter the vigour of the image; thus rendering it necessary to subject the plate immediately to the action of the mercury.

"This also explains why exposing the plate too long a time in the bromine-box gives a clouded image; for, when that happens, instead of merely impregnating the coating of iodide, the bromine reaches the silver of the plate and produces a bromide of silver, which is very injurious to the distinctness of the image.

"Lastly, they come to the conclusion that if, by the addition of new substances, the affinity of the accelerating vapour of the iodine can be augmented, the acceleration will become yet more considerable. This effect Messrs. Choiselet and St. Ratel have succeeded in obtaining, by employing various substances which they add to the bromine.

"Thus, they use one mixture composed of bromine and hydrobromic acid; another composed of 10 grammes of bromine and 3 of hydrobromic ether: they have also added to the bromine, as usually sold, some oil of naphtha; again, they have likewise substituted for bromine alone, some bromine into which 5 or 6 drops of oxhydric alcohol had been poured.

"As to the manner of employing these compounds, they have adopted the following process: in a bottle of the capacity of 2 decilitres they place, once for all, from 20 to 25 grammes of the accelerating substance; then, with a small graduated

syringe, made to contain 1 centilitre, and terminated by a tapering point, they draw from the bottle about half a centilitre of the vapour which floats therein. They inject this vapour into the bromine-box, by means of a small opening, which they afterwards close: nothing remains but to let the vapour mingle with the atmosphere of the box, which is done whilst iodizing the plate: the rest of the operation is performed in the ordinary way.

"Let us now direct our attention to the innovations of Messrs. Belfield, Lefevre, and Leon Foucault.

"Mr. Daguerre has long since considered that the polishing of the plates was attended with the effect of leaving on their surface a very thin coating of organic matter, which he imagined to be always prejudicial to the vigour of the proof; and he has thought it possible to remedy the evil by a modification in that important operation. This modification, of which we have given the details in the course of this work (see page 29), has not, in the opinion of Messrs. Belfield, Lefevre, and Foucault, the good effects that Mr. Daguerre attributes to it. They think that, instead of its depriving the plate of the coating of organic substances, it only spreads it uniformly over the surface. We intend further on to say a few words on the opinion of Mr. Daguerre; but one thing is certain, that the notion of the inadequacy of Mr. Daguerre's process above referred to, whether correct or erroneous, has led Messrs. Belfield and Lefevre to propose the following pro-

cess, which we give our readers without, in any way, guaranteeing its merits.

"The plate is polished with pounce and *unrectified* spirits of turpentine; the evaporation leaves on the surface of the plate a greyish pulverulent coating, of which it can be divested with the greatest facility, by rubbing it with a pledget of dry cotton. There then only remains on the polished surface of the silver a very thin filmy coating, which is rendered still thinner by rubbing the plate with a tampon steeped in alcohol at 45 degrees of strength, which is afterwards absorbed by a little powdered starch. The resinous coating is thereby uniformly spread over the plate, which will be ascertained by breathing on it. If it is not so spread, the various operations we have just enumerated must be again gone through.

"The plate is then placed over the iodine-box, and left until it assumes to the eye a greenish colour (that of an Athens green), and when seen by the reflection of a paper, of a rose-colour, bearing some analogy to that of the Provins rose.

"The plate is then exposed to the action of the bromine, and, for this purpose, a particular and very ingenious process is employed.

"Place in the bromine-box, at one of its sides, a cup, the rim of which is ground quite flat; on the edge of this cup place a piece of ground plate-glass: you then pour in 5 centigrammes of a solution of bromide of potassium, which contains one gramme of solid bromide in a pure state, and 20

grammes of water. You add to this solution a drop of nitric acid. You then shut the box, the lid of which becomes saturated with the vapour of bromine, and when you suppose this saturation to be complete, you incline the box, so as to make the glass lid which covers the half of the cup, slide on to it to shut in the vapour. Nothing then remains, but to put the plate in the box; the rest of the operation being performed in the ordinary way.

"The bromine process of Messrs. Choiselet and St. Ratel, may be substituted for the one we have just described.

"One word more on this process.

"If we follow the opinion of Mr. Daguerre, who is certainly a competent authority on the subject, this process of Messrs. Belfield and Foucault does not present any other advantage, than that of abridging the polishing of the plate, and of leaving on the surface of the silver a resinous coating, which absorbs the free iodine which is so injurious, according to the opinion of Messrs. Choiselet and St. Ratel, with which Mr. Daguerre entirely coincides.

"This perhaps would tend to explain how it is, that this process does accelerate *a little* the formation of the images; but as to the ideas which have led Messrs. Belfield and Foucault to consider the presence of this organic coating as *necessary*, and to believe that an image could not be produced on a plate, whose surface should be chemically pure, Mr. Daguerre considers them as quite erroneous.

"To resume our opinion on this subject, this process is new; but we may add, that the advantages which it offers are not yet sufficiently evident; and if we abstain from giving a definitive opinion on the subject, it is because we think it will be easy for those of our readers who are experimentalists to test its merits."

NOTE ON THE TITHONOTYPE, BY DR. DRAPER.

(*Extracted from the London, Edinburgh and Dublin Philosophical Magazine for September*, 1843.)

In the number of this journal for May last, I described a process for obtaining tithonotypes, or copies of the surface of Daguerreotypes, by means of gelatine.

A very important improvement on that process, an improvement which, indeed, has brought it almost at once to perfection; has been effected;—this is, to copy the surface in copper by the Electrotype after it has been previously fixed by the agency of a film of gold.

Those who are conversant with these matters will see at once that this is a very different thing from the abortive attempts which were made early in the history of the Daguerreotype. Many artists endeavoured to transfer its surface by precipitating copper upon it; among others, I made trials of the kind. The results of those abortive attempts were mere shadowy representations which could be seen in

certain lights, and which were very unsatisfactory in their effect.

The beautiful tithonotypes that are now so common in this city, are made in the following way:—The Daguerreotype plate is carefully gilt by M. Fizeau's process, taking care that the film of gold is neither too thick nor too thin. The proper thickness is readily attained after a little practice. The plate is then kept a day or two, so that it may become enfilmed with air. The back and edges being varnished, copper is to be deposited upon it in the usual way, the process occupying from twelve to twenty hours. If the plate has been properly gilt, and the process conducted successfully, the tithonotype readily splits off from the Daguerreotype.

The reader will understand, that, when the process succeeds, the Daguerreotype plate will be uninjured, and the tithonotype a perfect copy of it. If any portions are blue, or white, or flesh-coloured, they will be seen in the same colours in the tithonotype; the intensity of light and shadow is also given with accuracy, and indeed, the copy is a perfect copy in all respects of the original. A great advantage is also obtained in the reversal that takes place: the right side of the tithonotype corresponds to the right side of the original object, and the left to the left. In the Daguerreotype it is not so.

Copper tithonotypes were first made in this city, (New York,) by Mr. Endicott, a lithographic artist of distinction.

There is no great difficulty in obtaining from these tithonotypes duplicate copies. An expert artist can multiply them one from another.

The problem of multiplying the beautiful productions of M. Daguerre is therefore solved.

I will take this opportunity of making a remark which I intended to have inserted in my paper "On the rapid Detithonizing Power of certain Gases and Vapours." Amateurs, in the Daguerreotype process, are often annoyed by the want of success which frequently attends them. They ascribe to the atmosphere, or to the light, or to other causes, their inability to obtain impressions. Most of these mischances are due to the accidental presence of the vapour of iodine, or other electro-negative bodies, in the chamber or about the apparatus. It is incredible what a brief exposure to these vapours will entirely destroy a picture before it is mercurialised. If the iodine box or the bromine bottle is kept in the same room with the mercury apparatus, that circumstance in itself is often sufficient to insure an uniform want of success. If the little frame which fits into the back of the camera, and which holds the silver plate, be used in the iodizing process, as is often the case, the small quantity of vapour it absorbs will destroy every picture, or, at all events, increase the time required in the camera enormously. The reason of this is easily understood. Suppose a plate, in such a frame, be placed in the camera, or what comes to the same thing, suppose a particle of iodine has fallen

into the camera, or that the wood has in any way absorbed an electro-negative vapour; as fast as the light makes its impression on the sensitive surface, the vapour detithonises it, and unless the light is quite intense, or the exposure much prolonged, a very feeble proof, or no proof at all, will be obtained. In the same way the difficulties are greatly increased in the process of mercurialisation, for, the temperature resorted to being high, if there is the least particle of iodine about the box, the picture will be inevitably and instantly detithonised and ruined.

We ought, therefore, never to allow iodine, or bromine, or chlorine, to have access to the apartment or the apparatus in which Daguerreotype operations are being conducted.

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MR. DAGUERRE'S NORMAL APPARATUS, improved, constructed of walnut-tree wood, with an object-glass of 0^{m} .08 ; and chemicals complete, including six plates containing 1-30th of silver, 0^{m} .16 by 0^{m} .22, &c. *	260
Ditto, do., called half-plate apparatus, the wood-work in walnut-tree wood, the same accessories as with the larger ones	150
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Daguerreotype upon Gaudin's system	90
NEW DAGUERREOTYPE for plates of the 1-6th size	90

This model, which acts as promptly as the preceding one, is superior to all the other apparatus in respect to its arrangement.

The camera, the plate-box, and the mercury-box, are contained in one

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*** We guarantee the object-glasses, the plates, and everything that we deliver with our apparatus, as being of the best quality: rather than diminish the price to the detriment of the quality, we have endeavoured to render them as perfect as possible in every respect. The book, and two lessons, will be given gratis, by the operators attached to our establishment, to all persons purchasing an apparatus.**

small box, so that the operator has, in a very small compass, all that is necessary to operate with during a whole day. The chemicals are contained in a second box entirely separate, and comprise large bottles of all the ordinary substances; the chloride of gold, the saturated bromine-water, in a bottle marked with divisions, and another with the normal bromine-mixture ready for use; the flat square pan, the fixing-stand, the frames to keep the bromine-plates, &c. &c.*

	Fr.
Apparatus of the quarter-plate size, entirely similar to the above	120
Ditto, with double object-glass	150
Apparatus of the half-plate size, with a single object-glass	170
Ditto, do., with a double object-glass	220
Ditto, with single object-glass for whole plate	300
Ditto, with double object-glass, to which is added a third object-glass, destined more especially for the portrait	400
Apparatus ditto, with double object-glass, of 0m .11 in diameter for plates of the size of 24 centimetres by 32	800
NEW CLAUDET APPARATUS.—This apparatus has the advantage of serving with all sorts of object-glasses, whether simple or compound, and for all sizes of plates. It is strongly made, and well contrived for adjusting the focus, and for placing the plate in the camera and withdrawing it. This construction is very simple, and not liable to get out of order; it gives to amateurs the greatest facility for adapting trial lenses to the camera; with double object-glasses for half, quarter, and one-sixth sizes	400
LARGE CLAUDET APPARATUS, which may be used with all sizes of plates	600
Achromatic Object-Glass for the one-sixth size	8
Ditto, with its variable diaphragm mounting and rack	20
Achromatic Object-Glass for the one-fourth size	15

* The advantages attending the use of this construction, which is *more complete than any other*, and in which the camera, as well as the mercury-box, are not liable to the risk of being deteriorated by the emanations of the accelerating substances, have made us determine to adopt it for all the dimensions which follow.

	Fr.
Achromatic Object-glass, with its mounting without rack .	25
Double ditto, ditto, mounted with rack	60
Achromatic Object-Glass for one-half size	25
Double ditto, mounted, with rack	100
Achromatic Object-Glass of 0m .08 in diameter . . .	60
Ditto, with its mounting	80
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The double Object-Glasses are advantageous, especially for the larger apparatus, inasmuch as they operate much more rapidly than those formerly used.

Parallel Glass Reflector for the apparatus of 70 francs .	25
Ditto for those of 90 francs, and for the one-fourth size .	35
Ditto for the half plate, and whole plate . .	50 & 60

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Of 0.16 by 0.22 . . .	4	50	Of 0.16 by 0.22	9
For half the above size	3	0	For half the above size .	6
For one-fourth ,,	1	50	For one-fourth ,, . .	3
For one-sixth ,,	1	0	For one-sixth ,, . .	2

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Common, per ten frames ; for plates m. m.	fr.	Painted on glass, with black-line border, per ten ; for plates m. m.	fr.	Painted on glass with gilt border, per ten ; for plates m. m.	Fr.
Of 0.16 by 0.22	18	Of 0.16 by 0.22	25	Of 0.16 by 0.22	30
Half the above	10	Half the above	15	Half the above	18
One-fourth ,,	4	One-fourth ,,	10	One-fourth ,,	12
One-sixth ,,	3	One-sixth ,,	7	One-Sixth ,,	9

CASES FOR PORTRAITS, EMBOSSED AND OTHER FRAMES.

INSTRUMENT ON WHICH THE PLATE IS POLISHED.

m. m.	Fr.	c.
For Plates of 0.16 by 0.22	3	50
,, half the above size	3	0

	Fr.	c.
For plates of one-quarter the foregoing size . . .	2	75
„ one-sixth „ „	2	05
Polishing buff covered with velvet, to give the finishing touch to the plates	1	50
Ditto, with handle for large plates	3	0

PLATE BOXES.

For Plates of 0.16 m. by 0.22 m.	5	0
„ half the above size	4	0
„ one-fourth „	3	0
„ one-sixth „	2	50

PANS FOR THE BROMINE-WATER, AND OTHER ACCELERATING SUBSTANCES.

For Plates of 0.16 m. by 0.22 m.	5	0
„ half the above size	4	0
„ one-fourth „	3	0
„ one-sixth „	2	0
„ one-sixth „ without frame	2	50
Yellow and Red Glass for Mr. Becquerel's Accelerating Processes, and for the Mercury-boxes of the Apparatus, of 16 centimètres square . . . . . 2 and	3	0
A Bag of Emery, per 500 grammes	4	0
Calcined Tripoli, per kilogramme	8	0
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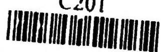
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